
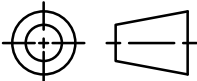


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APPLICATION		REVISION HISTORY					
NEXT ASSY	USED ON	PART NO.	ZONE	REV	DESCRIPTION	DATE	APPROVAL

## TECHNICAL SPECIFICATION FOR DRAWING 76K39667

DOCUMENT INFORMATION: (TITLE, NUMBER, REV, DATE) <b>MODIFY VEHICLE ASSEMBLY BUILDING HIGH BAY 3 FOR SLS - HOISTS, PCN 99000.5, REV BASIC, AUGUST 20, 2013</b>					
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UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994. TOLERANCES ON: FRACTIONS    DECIMALS    ANGLES $\pm 1/16$ 1 PL $\pm .060$ 1 PL + .1 2 PL $\pm .030$ 3 PL $\pm .010$	
THIRD ANGLE PROJECTION	
	

CAD MAINTAINED. CHANGES SHALL BE INCORPORATED ONLY BY THE DESIGN ACTIVITY.		ORIGINAL DATE OF DRAWING 2013/08/20		JOHN F. KENNEDY SPACE CENTER, NASA KENNEDY SPACE CENTER, FLORIDA			
SOFTWARE AUTOCAD		APPROVED		<b>MODIFY VEHICLE ASSEMBLY BUILDING HIGH BAY 3 FOR SLS HOISTS</b>			
FILENAME 79K39668_HOISTS.dwg		A&E PM : R. PRUSS					
MATERIAL		NASA PM/LDE: M. HARTNETT					
HEAT TREATMENT		NASA BrMgr: W. SCHROEDER		SIZE <b>A</b>	CAGE CODE 22264	DWG NO <b>79K39668</b>	REV
FINAL PROTECTIVE FINISH				SCALE NOTED	UNIT WEIGHT	SHEET 1 OF 259	

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SECTION 01 11 00

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- 1.3 CONTRACT DRAWINGS
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- 1.5 OCCUPANCY OF PREMISES
- 1.6 EXISTING WORK
- 1.7 ON-SITE PERMITS
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## SECTION 01 11 00

## SUMMARY OF WORK

## PART 1 GENERAL

## 1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval and information only. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

## SD-01 Preconstruction Submittals

Submit the following items to the Contracting Officer:

Utility Outage Requests; G  
Utility Connection Requests; G  
Welding Permits; G  
Burning Permits; G

## 1.2 WORK COVERED BY CONTRACT DOCUMENTS

## 1.2.1 Project Description

The work to be performed under this contract requires providing the labor, equipment, and materials to modify the existing Vehicle Assembly Building (VAB) and construct new hoists and related systems for the new Space Launch System (SLS). The primary deconstruction, demolition, and construction site is the VAB at Kennedy Space Center, Florida.

The work consists of demolition of existing structural and component systems; modification and reuse of existing structural components; construction and installation of new structural, mechanical, and electrical materials, systems, and equipment; reinstallation of modified and unmodified systems.

The work consists of removal and storage of existing system components, equipment, and materials for reuse/reinstallation; demolition of system components and structure not to be reused; modification of structural elements and installation of new structural elements; reinstallation of salvaged equipment and materials, and installation of new systems, equipment, and materials.

Demolition and construction will take place in High Bay (HB) 3. A total of sixteen hoists and related mechanical, structural, electrical, and life safety systems will be constructed.

## 1.3 CONTRACT DRAWINGS

The following drawings accompany this specification and are a part thereof.

Drawing No. 79K39667

#### Sheets 1 through 41

Five sets of full size contract drawings, maps, and specifications will be furnished to the Contractor without charge. Reference publications will not be furnished.

Contractor shall immediately check furnished drawings and notify the Government of any discrepancies.

#### 1.4 PROJECT ENVIRONMENTAL GOALS

Contractor shall distribute copies of the Environmental Goals to each subcontractor and the Contracting Officer. The overall goal for design, construction, and operation is to produce a facility that meets the functional program needs and incorporates the principles of sustainability. Specifically:

- a. Preserve and restore the site ecosystem and biodiversity; avoid site degradation and erosion. Minimize offsite environmental impact.
- b. Use the minimum amount of energy, water, and materials feasible to meet the design intent. Select energy and water efficient equipment and strategies.
- c. Use environmentally preferable products and decrease toxicity level of materials used.
- d. Use renewable energy and material resources.
- e. Optimize operational performance (through commissioning efforts) in order to ensure energy efficient equipment operates as intended. Consider the durability, maintainability, and flexibility of facility systems.
- f. Manage construction site and storage of materials to ensure no negative impact on the indoor environmental quality of the facility.
- g. Reduce construction waste through reuse, recycling, and supplier take-back.

#### 1.5 OCCUPANCY OF PREMISES

The VAB will be occupied during performance of work under this Contract.

Before work is started, the Contractor shall arrange with the Contracting Officer a sequence of procedure, means of access, space for storage of materials and equipment, and use of approaches, corridors, and stairways.

#### 1.6 EXISTING WORK

In addition to "FAR 52.236-9, Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements":

- a. Remove or alter existing work in such a manner as to prevent injury or damage to any portions of the existing work which remain.
- b. Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as approved by the Contracting Officer. At the

completion of operations, existing work shall be in a condition equal to or better than that which existed before new work started.

## 1.7 ON-SITE PERMITS

### 1.7.1 Utility Outage Requests and Utility Connection Requests

Notify the Contracting Officer at least 72 hours prior to starting excavation work. Contractor is responsible for marking and verifying all utilities not marked.

The Contractor shall verify the elevations of existing piping, utilities, and any type of underground obstruction not indicated or specified to be removed. But indicated in locations to be transversed by piping, ducts, and other work to be installed. Verify elevations before installing new work closer than nearest manhole or other structure at which an adjustment in grade can be made.

Work shall be scheduled to hold outages to a minimum.

### 1.7.2 Welding and Burning Permits

<u>ACTIVITY</u>	<u>SUBMISSION DATE</u>	<u>SUBMISSION FORM</u>
Burning Permits	24 hours prior to work	Call (321) 861-5050
Welding Permits	24 hours prior to work	Call (321) 861-5050

Permits shall be posted at a conspicuous location in the construction area.

Burning of trash or rubbish is not permitted on project site.

## 1.8 SALVAGE MATERIAL AND EQUIPMENT

Items designated by the Contracting Officer to be salvaged shall remain the property of the Government.

The salvaged property shall be segregated, itemized, delivered, and off-loaded at the Government designated storage area located within 10 miles of the construction site.

Contractor shall maintain property control records for material or equipment designated as salvage. Contractor's system of property control may be used if approved by the Contracting Officer. Contractor shall be responsible for storage and protection of salvaged materials and equipment until disposition by the Contracting Officer.

## PART 2 PRODUCTS

Not used.

## PART 3 EXECUTION

Not used.

-- End of Section --

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SECTION 01 33 00

SUBMITTAL PROCEDURES

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1.2.3 Work

1.3 SUBMITTALS

1.4 SUBMITTAL REGISTER

PART 2 PRODUCTS

PART 3 EXECUTION

-- End of Section Table of Contents --

## SECTION 01 33 00

## SUBMITTAL PROCEDURES

## PART 1 GENERAL

## 1.1 SUMMARY

The Contracting Officer may request submittals in addition to those specified when deemed necessary to adequately describe the work covered in the respective sections.

Units of weights and measures used on all submittals are to be the same as those used in the contract drawings.

Each submittal is to be complete and in sufficient detail to allow ready determination of compliance with contract requirements.

Contractor's Quality Control (CQC) System Manager and the Designer of Record, if applicable, to check and approve all items prior to submittal and stamp, sign, and date indicating action taken. Proposed deviations from the contract requirements are to be clearly identified. Include within submittals items such as: Contractor's, manufacturer's, or fabricator's drawings; descriptive literature including (but not limited to) catalog cuts, diagrams, operating charts or curves; test reports; test cylinders; samples; O&M manuals (including parts list); certifications; warranties; and other such required submittals.

Submittals requiring Government approval are to be scheduled and made prior to the acquisition of the material or equipment covered thereby. Pick up and dispose of samples not incorporated into the work in accordance with manufacturer's Material Safety Data Sheets (MSDS) and in compliance with existing laws and regulations.

## 1.2 DEFINITIONS

## 1.2.1 Submittal Descriptions (SD)

Submittals requirements are specified in the technical sections. Submittals are identified by Submittal Description (SD) numbers and titles as follows:

**SD-01 Preconstruction Submittals**

Submittals which are required prior to start of construction (work) issuance of contract notice to proceed or commencing work on site or the start of the next major phase of the construction on a multi-phase contract, includes schedules, tabular list of data, or tabular list including location, features, or other pertinent information regarding products, materials, equipment, or components to be used in the work.

Certificates of insurance

Surety bonds

List of proposed Subcontractors



List of proposed products

Construction progress schedule

Network Analysis Schedule (NAS)

Submittal register

Schedule of prices

Health and safety plan

Work plan

Quality Control (QC) plan

Environmental protection plan

#### SD-02 Shop Drawings

Drawings, diagrams and schedules specifically prepared to illustrate some portion of the work.

Diagrams and instructions from a manufacturer or fabricator for use in producing the product and as aids to the Contractor for integrating the product or system into the project.

Drawings prepared by or for the Contractor to show how multiple systems and interdisciplinary work will be coordinated.

#### SD-03 Product Data

Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions and brochures illustrating size, physical appearance and other characteristics of materials, systems or equipment for some portion of the work.

Samples of warranty language when the contract requires extended product warranties.

#### SD-04 Samples

Fabricated or unfabricated physical examples of materials, equipment or workmanship that illustrate functional and aesthetic characteristics of a material or product and establish standards by which the work can be judged.

Color samples from the manufacturer's standard line (or custom color samples if specified) to be used in selecting or approving colors for the project.

Field samples and mock-ups constructed on the project site establish standards by which the ensuring work can be judged. Includes assemblies or portions of assemblies which are to be incorporated into the project and those which will be removed at conclusion of the work.

#### SD-05 Design Data

Design calculations, mix designs, analyses or other data pertaining to a part of work.

Design submittals, design substantiation submittals and extensions of design submittals.

#### SD-06 Test Reports

Report signed by authorized official of testing laboratory that a material, product or system identical to the material, product or system to be provided has been tested in accord with specified requirements. (Testing must have been within three years of date of contract award for the project.)

Report which includes findings of a test required to be performed by the Contractor on an actual portion of the work or prototype prepared for the project before shipment to job site.

Report which includes finding of a test made at the job site or on sample taken from the job site, on portion of work during or after installation.

Investigation reports.

Daily logs and checklists.

Final acceptance test and operational test procedure.

#### SD-07 Certificates

Statements printed on the manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements. Must be dated after award of project contract and clearly name the project.

Document required of Contractor, or of a manufacturer, supplier, installer or Subcontractor through Contractor, the purpose of which is to further quality of orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel qualifications.

Confined space entry permits.

Text of posted operating instructions.

#### SD-08 Manufacturer's Instructions

Preprinted material describing installation of a product, system or material, including special notices and (MSDS) concerning impedances, hazards and safety precautions.

#### SD-09 Manufacturer's Field Reports

Documentation of the testing and verification actions taken by manufacturer's representative at the job site, in the vicinity of the job site, or on a sample taken from the job site, on a portion of the work, during or after installation, to confirm compliance with manufacturer's standards or instructions. The documentation must be

signed by an authorized official of a testing laboratory or agency and must state the test results; and indicate whether the material, product, or system has passed or failed the test.

Factory test reports.

#### SD-10 Operation and Maintenance Data

Data that is furnished by the manufacturer, or the system provider, to the equipment operating and maintenance personnel, including manufacturer's help and product line documentation necessary to maintain and install equipment. This data is needed by operating and maintenance personnel for the safe and efficient operation, maintenance and repair of the item.

This data is intended to be incorporated in an operations and maintenance manual or control system.

#### SD-11 Closeout Submittals

Documentation to record compliance with technical or administrative requirements or to establish an administrative mechanism.

Special requirements necessary to properly close out a construction contract. For example, Record Drawings and as-built drawings. Also, submittal requirements necessary to properly close out a major phase of construction on a multi-phase contract.

Interim "DD Form 250" with cost breakout for all assets 30 days prior to facility turnover.

#### 1.2.2 Approving Authority

Office or designated person authorized to approve submittal.

#### 1.2.3 Work

As used in this section, on- and off-site construction required by contract documents, including labor necessary to produce submittals, [except those SD-01 Pre-Construction Submittals noted above](#), construction, materials, products, equipment, and systems incorporated or to be incorporated in such construction.

#### 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor QC approval and for information only. Submit the following in accordance with this section.

##### SD-01 Preconstruction Submittals

Submittal Register; G

#### 1.4 SUBMITTAL REGISTER

Prepare and maintain a submittal register as the work progresses. Use electronic submittal register program furnished by the Contracting Officer or any other format approved by the Contracting Officer. The contracting officer will provide the initial submittal register.

The Contractor is to track all submittals by maintaining a complete list, including completion of all data columns, including dates on which submittals are received and returned by the Contracting Officer.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

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SOURCES FOR REFERENCE PUBLICATIONS

PART 1 GENERAL

1.1 REFERENCES

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## SECTION 01 42 00

## SOURCES FOR REFERENCE PUBLICATIONS

## PART 1 GENERAL

## 1.1 REFERENCES

Various publications are referenced in other sections of the specifications to establish requirements for the work. These references are identified in each section by document number, date and title. The document number used in the citation is the number assigned by the standards producing organization, (e.g. ASTM B564 Nickel Alloy Forgings). However, when the standards producing organization has not assigned a number to a document, an identifying number has been assigned for reference purposes.

## 1.2 ORDERING INFORMATION

The addresses of the standards publishing organizations whose documents are referenced in other sections of these specifications are listed below, and if the source of the publications is different from the address of the sponsoring organization, that information is also provided. Documents listed in the specifications with numbers which were not assigned by the standards producing organization must be ordered from the source by title rather than by number.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)  
38800 Country Club Drive  
Farmington Hills, MI 48331  
Ph: 248-848-3700  
Fax: 248-848-3701  
E-mail: [bkstore@concrete.org](mailto:bkstore@concrete.org)  
Internet: <http://www.concrete.org>

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)  
2111 Wilson Blvd, Suite 500  
Arlington, VA 22201  
Ph: 703-524-8800  
Fax: 703-528-3816  
E-mail: [fdietz@ahrinet.org](mailto:fdietz@ahrinet.org)  
Internet: <http://www.ahrinet.org>

ALUMINUM ASSOCIATION (AA)  
National Headquarters  
1525 Wilson Boulevard, Suite 600  
Arlington, VA 22209  
Ph: 703-358-2960  
Fax: 703-358-2961  
Internet: <http://www.aluminum.org>

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS  
(AASHTO)  
444 North Capital Street, NW, Suite 249  
Washington, DC 20001  
Ph: 202-624-5800

Fax: 202-624-5806  
E-Mail: [info@ashto.org](mailto:info@ashto.org)  
Internet: <http://www.ashto.org>

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)  
One East Wacker Drive, Suite 3100  
Chicago, IL 60601-2001  
Ph: 312-670-2400  
Fax: 312-670-5403  
Publications: 800-644-2400  
E-mail: [pubs@aisc.org](mailto:pubs@aisc.org)  
Internet: <http://www.aisc.org>

AMERICAN INDUSTRIAL HYGIENE ASSOCIATION (AIHA)  
3141 Fairview Park Dr., Suite 777  
Falls Church, VA 22042  
Ph: 703-849-8888  
Fax: 703-207-3561  
Publications: 703-849-8888  
E-mail: [infonet@aiha.org](mailto:infonet@aiha.org)  
Internet: <http://www.aiha.org>

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)  
1819 L Street, NW, 6th Floor  
Washington, DC 20036  
Ph: 202-293-8020  
Fax: 202-293-9287  
E-mail: [info@ansi.org](mailto:info@ansi.org)  
Internet: <http://www.ansi.org/>

--- ANSI documents beginning with the letter "S" can be ordered from:

Acoustical Society Of America  
2 Huntington Quadrangle, Suite 1N01  
Melville, NY 11747-4502  
Ph: 516-576-2360  
Fax: 516-576-2377  
E-mail: [asa@aip.org](mailto:asa@aip.org)  
Internet: <http://asa.aip.org>

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)  
1711 Arlingate Lane  
P.O. Box 28518  
Columbus, OH 43228-0518  
Ph: 800-222-2768; 614-274-6003  
Fax: 614-274-6899  
E-mail: [webmaster@asnt.org](mailto:webmaster@asnt.org)  
Internet: <http://www.asnt.org>

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)  
1800 East Oakton Street  
Des Plaines, IL 60018-2187  
Ph: 847-699-2929  
Fax: 847-768-3434  
E-mail: [customerservice@asse.org](mailto:customerservice@asse.org)  
Internet: <http://www.asse.org>

ASME INTERNATIONAL (ASME)  
Three Park Avenue  
New York, NY 10016-5990  
Ph: 212-591-7722  
Fax: 212-591-7674  
Internet: [www.asme.org](http://www.asme.org)

AMERICAN WELDING SOCIETY (AWS)  
550 N.W. LeJeune Road  
Miami, FL 33126  
Ph: 800-443-9353 - 305-443-9353  
Fax: 305-443-7559  
E-mail: [info@aws.org](mailto:info@aws.org)  
Internet: <http://www.aws.org>

ASTM INTERNATIONAL (ASTM)  
100 Barr Harbor Drive, P.O. Box C700  
West Conshohocken, PA 19428-2959  
Ph: 610-832-9500  
Fax: 610-832-9555  
E-mail: [service@astm.org](mailto:service@astm.org)  
Internet: <http://www.astm.org>

CALIFORNIA ENERGY COMMISSION (CEC)  
Media and Public Communications Office  
1516 Ninth Street, MS-29  
Sacramento, CA 95814-5512  
Ph: 916-654-4287  
Internet: <http://www.energy.ca.gov/>

CRANE MANUFACTURERS ASSOCIATION OF AMERICA (CMAA)  
8720 Red Oak Boulevard, Suite 201  
Charlotte, NC 28217-3992  
Ph: 704-676-1190  
Fax: 704-676-1199  
Internet: [www.mhia.org/psc/PSC\\_Products\\_Cranes.cfm](http://www.mhia.org/psc/PSC_Products_Cranes.cfm)

ELECTRONIC INDUSTRIES ALLIANCE (EIA)  
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Arlington, VA 22201-3834  
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Fax: 703-907-7501  
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Fax: 404-346-3332

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120 Wall Street, 17th Floor  
New York, NY 10005  
Ph: 212-248-5000  
Fax: 212-248-5018  
E-mail: [IES@IES.org](mailto:IES@IES.org)



Internet: <http://www.IES.org>

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)  
445 Hoes Lane  
Piscataway, NJ 08855-1331  
Ph: 732-981-0060  
Fax: 732-981-1712  
E-mail: [customer-services@ieee.org](mailto:customer-services@ieee.org)  
Internet: <http://www.ieee.org>

INTERNATIONAL CODE COUNCIL (ICC)  
5360 Workman Mill Road  
Whittier, CA 90601  
Ph: 1-888-422-7233  
Fax: 562-908-5524  
E-mail: [webmaster@iccsafe.org](mailto:webmaster@iccsafe.org)  
Internet: [www.iccsafe.org](http://www.iccsafe.org)

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)  
P.O. Box 687  
106 Stone Street  
Morrison, CO 80465  
Ph: 303-697-8441  
Fax: 303-697-8431  
E-mail: [neta@netaworld.org](mailto:neta@netaworld.org)  
Internet: <http://www.netaworld.org>

IPC - ASSOCIATION CONNECTING ELECTRONICS INDUSTRIES (IPC)  
3000 Lakeside Drive, 309S  
Bannockburn, IL 60015  
Ph: 847-615-7100  
Fax: 847-615-7105  
E-mail: [webmaster@ipc.org](mailto:webmaster@ipc.org)  
Internet: <http://www.ipc.org>

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## SECTION 01 57 20.00 10

## ENVIRONMENTAL PROTECTION

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## FLORIDA ADMINISTRATIVE CODE (FAC)

Chapter 62-710	Used Oil Management
Chapter 62-730	Hazardous Waste
Chapter 62-737	Mercury Containing Lamps and Devices Destined for Recycling
Chapter 62-770	Petroleum Contamination Site Clean Up Criteria

## JOHN F. KENNEDY SPACE CENTER (KSC)

KNPR 8500.1	(2010; Rev B)KSC Environmental Requirements
NPR 8530.1A	(2009; Change 3) Affirmative Procurement Program and Plan for Environmentally Preferable Products

## U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

33 CFR 328	Definitions of Waters of the United States
40 CFR 247	Comprehensive Procurement Guideline for Products Containing Recovered Materials
40 CFR 260	Hazardous Waste Management System: General
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Standards Applicable to Generators of Hazardous Waste
40 CFR 265	Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 273	Standards For Universal Waste Management
40 CFR 279	Standards for the Management of Used Oil

40 CFR 302	Designation, Reportable Quantities, and Notification
40 CFR 355	Emergency Planning and Notification
40 CFR 68	Chemical Accident Prevention Provisions
40 CFR 761	Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions

## 1.2 DEFINITIONS

### 1.2.1 Biobased Content

"Biobased content" is calculated as the weight of the biobased material divided by the total weight of the product, and is expressed as a percentage by weight.

### 1.2.2 Biobased Materials

"Biobased Materials" include fuels, chemicals, building materials or electric power or heat produced from biomass as defined by the Biomass R&D Act. Minimum biobased content shall be as defined in the U.S. Farm Bill.

### 1.2.3 Life-Cycle Cost Analysis

"Life-cycle cost analysis" is a comparison of the amortized annual cost of using a product with respect to a product that it not Comprehensive Procurement Guideline (CPG) compliant, biobased, environmentally preferable, energy-efficient, water-efficient, recycled-content, and non-ozone depleting or are non-toxic or less toxic. Cost under consideration include capital costs, installation costs, operating costs, maintenance costs, and disposal costs discounted over the lifetime of the product.

### 1.2.4 Environmental Pollution and Damage

Environmental pollution and damage is the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade the environment aesthetically, culturally and/or historically.

### 1.2.5 Environmental Protection

Environmental protection is the prevention/control of pollution and habitat disruption that may occur to the environment during construction. The control of environmental pollution and damage requires consideration of land, water, and air; biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive material as well as other pollutants.

### 1.2.6 Contractor Generated Hazardous Waste

Contractor generated hazardous waste means materials that, if abandoned or disposed of, may meet the definition of a hazardous waste. These waste streams would typically consist of material brought on site by the



Contractor to execute work, but are not fully consumed during the course of construction. Examples include, but are not limited to, excess paint thinners (i.e. methyl ethyl ketone, toluene etc.), waste thinners, excess paints, excess solvents, waste solvents, and excess pesticides, and contaminated pesticide equipment rinse water.

#### 1.2.7 Land Application for Discharge Water

The term "Land Application" for discharge water implies that the Contractor must discharge water at a rate which allows the water to percolate into the soil. No sheeting action, soil erosion, discharge into storm sewers, discharge into defined drainage areas, or discharge into the "waters of the United States" must occur. Land Application must be in compliance with applicable Federal, State, and local laws and regulations.

#### 1.2.8 Surface Discharge

The term "Surface Discharge" implies that the water is discharged with possible sheeting action and subsequent soil erosion may occur. Waters that are surface discharged may terminate in drainage ditches, storm sewers, creeks, and/or "waters of the United States" and would require a permit to discharge water from the governing agency.

#### 1.2.9 Waters of the United States

All waters which are under the jurisdiction of the Clean Water Act, as defined in 33 CFR 328.

#### 1.2.10 Wetlands

Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, and bogs. Official determination of whether or not an area is classified as a wetland must be done in accordance with KSC Environmental.

### 1.3 GENERAL REQUIREMENTS

Minimize environmental pollution and damage that may occur as the result of construction operations. The environmental resources within the project boundaries and those affected outside the limits of permanent work must be protected during the entire duration of this contract. Comply with Federal, State, and local environmental laws and regulations. Delays resulting from failure to comply with environmental laws and regulations shall be the Contractor's responsibility.

### 1.4 SUBCONTRACTORS

Ensure compliance with this section by subcontractors.

### 1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

## Environmental Protection Plan; G

### 1.6 ENVIRONMENTAL PROTECTION PLAN

Prior to commencing construction activities or delivery of materials to the site, submit an Environmental Protection Plan for review and approval by the Contracting Officer. The purpose of the Environmental Protection Plan is to present a comprehensive overview of known or potential environmental issues which the Contractor must address during construction. Issues of concern must be defined within the Environmental Protection Plan as outlined in this section. Address each topic at a level of detail commensurate with the environmental issue and required construction task(s). Topics or issues which are not identified in this section, but are considered necessary, must be identified and discussed after those items formally identified in this section. Prior to submittal of the Environmental Protection Plan, meet with the Contracting Officer for the purpose of discussing the implementation of the initial Environmental Protection Plan; possible subsequent additions and revisions to the plan including reporting requirements; and methods for administration of the Contractor's Environmental Plans. The Environmental Protection Plan must be current and maintained onsite by the Contractor.

#### 1.6.1 Compliance

No requirement in this Section will relieve the Contractor of Federal, State, and local environmental protection laws and regulations. During Construction, the Contractor shall be responsible for identifying, implementing, and submitting for approval additional requirements to be included in the Environmental Protection Plan.

#### 1.6.2 Contents

Include in the Environmental Protection Plan, but not limit it to, the following:

- a. Name(s) of person(s) within the Contractor's organization who is(are) responsible for ensuring adherence to the Environmental Protection Plan.
- b. Name(s) and qualifications of person(s) responsible for manifesting hazardous waste to be removed from the site, if applicable.
- c. Name(s) and qualifications of person(s) responsible for training the Contractor's environmental protection personnel.
- d. Description of the Contractor's environmental protection personnel training program.
- e. An erosion and sediment control plan which identifies the type and location of the erosion and sediment controls to be provided. The plan must include monitoring and reporting requirements to assure that the control measures are in compliance with the erosion and sediment control plan, Federal, State, and local laws and regulations. A Storm Water Pollution Prevention Plan (SWPPP) may be substituted for this plan.
- f. Traffic control plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather. Plan shall include measures to minimize the amount of mud transported onto

paved public roads by vehicles or runoff.

- g. Work area plan showing the proposed activity in each portion of the area and identifying the areas of limited use or nonuse. Plan should include measures for marking the limits of use areas including methods for protection of features to be preserved within authorized work areas.
- h. The Contractor's spill control plan shall include the procedures, instructions, and reports in accordance with the contract clause "spill" to be used in the event of an unforeseen spill of a substance regulated by 40 CFR 68, 40 CFR 302, 40 CFR 355, or regulated under State or Local laws and regulations. The Contractor's spill control plan supplements the requirements of KNPR 8500.1, Rev B, KSC Requirements. Include in this plan, as a minimum:
  - (1) The name of the individual who shall report spills or hazardous substance releases and who shall follow up with complete documentation. This individual shall immediately notify the Contracting Officer and the Environmental Assurance Branch in addition to the legally required Federal, State, and local reporting channels (including the National Response Center 1-800-424-8802) if a reportable quantity is released to the environment. Include in the plan a list of the required reporting channels and telephone numbers.
  - (2) The name and qualifications of the individual who shall be responsible for implementing and supervising the containment and cleanup.
  - (3) Training requirements for Contractor's personnel and methods of accomplishing the training.
  - (4) A list of materials and equipment to be immediately available at the job site, tailored to cleanup work of the potential hazard(s) identified.
  - (5) The names and locations of suppliers of containment materials and locations of additional fuel oil recovery, cleanup, restoration, and material-placement equipment available in case of an unforeseen spill emergency.
  - (6) The methods and procedures to be used for expeditious contaminant cleanup.
- i. A Non-hazardous Solid Waste Disposal Plan identifying methods and locations for solid waste disposal including clearing debris and schedules for disposal.
  - (1) Identify subcontractors responsible for the transportation and disposal of solid waste. Submit licenses or permits for solid waste disposal sites that are not a commercial operating facility.
  - (2) Evidence of the disposal facility's acceptance of the solid waste must be attached to this plan during the construction. Attach a copy of each of the Non-hazardous Solid Waste Diversion Reports to the disposal plan. Non-hazardous Solid Waste Diversion Reports shall be submitted using KSC Form 7-648NS (Rev. 12/08) to the Contracting Officer by December 31 of each year or at the closeout of the project, whichever occurs first.

- (3) Indicate in the report the total amount of waste generated and total amount of waste diverted in cubic yards or tons along with the percent that was diverted.
  - (4) A recycling and solid waste minimization plan with a list of measures to reduce consumption of energy and natural resources. Detail in the plan the Contractor's actions to comply with and to participate in Federal, State, Regional, and local government sponsored recycling programs to reduce the volume of solid waste at the source.
- j. A Hazardous Waste Management Plan that identifies processes, operations and safety procedures that are site specific for the location and nature of hazardous and controlled waste, which includes and not limited to chemicals, paints, removed paints and coatings, solvents, aerosol cans, petroleum, oil and lubricant (POL) products, lamps, ballasts, mercury switches, etc. and their containers, as defined in 40 CFR 261, 40 CFR 273, 40 CFR 279, or 40 CFR 761.
  - k. An Air Pollution Control Plan detailing provisions to assure that dust, debris, materials, trash, etc., do not become air borne and travel off the project site.
  - l. A Contaminant Prevention Plan that: identifies potentially hazardous substances to be used on the job site; identifies the intended actions to prevent introduction of such materials into the air, water, or ground; and details provisions for compliance with Federal, State, and local laws and regulations for storage and handling of these materials. In support of KNPR 8500.1, Rev B, KSC Requirements., a copy of the Material Safety Data Sheets (MSDS) and the maximum quantity of each hazardous material to be onsite must be included in the contaminant prevention plan. Update the plan as new hazardous materials are brought onsite or removed from the site.
  - m. A waste water management plan that identifies the methods and procedures for management and/or discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water, and water used in flushing of lines. If a settling/retention pond is required, the plan must include the design of the pond including drawings, removal plan, and testing requirements for possible pollutants. If land application will be the method of disposal for the waste water, the plan must include a sketch showing the location for land application along with a description of the pretreatment methods to be implemented. If surface discharge will be the method of disposal, include a copy of the permit and associated documents as an attachment prior to discharging the waste water. If disposal is to a sanitary sewer, the plan must include documentation that the Waste Water Treatment Plant Operator has approved the flow rate, volume, and type of discharge.

### 1.6.3 Appendix

Attach to the Environmental Protection Plan, as an appendix, copies of environmental permits, permit application packages, approvals to construct, notifications, certifications, reports, and termination documents.

## 1.7 PROTECTION FEATURES

This paragraph supplements the Contract Clause PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS. Prior to start of on-site construction activities, the Contractor and the Contracting Officer will make a joint condition survey. Immediately following the survey, the Contractor shall prepare a brief report including a plan describing the features requiring protection under the provisions of the Contract Clauses, which are not specifically identified on the drawings as environmental features requiring protection along with the condition of trees, shrubs and grassed areas immediately adjacent to the site of work and adjacent to the Contractor's assigned storage area and access route(s), as applicable. This survey report will be signed by both the Contractor and the Contracting Officer upon mutual agreement as to its accuracy and completeness. The Contractor must protect those environmental features included in the survey report and indicated on the drawings, regardless of interference which their preservation may cause to the work under the contract.

## 1.8 ENVIRONMENTAL ASSESSMENT OF CONTRACT DEVIATIONS

Deviations from the drawings, plans and specifications, requested by the Contractor and which may have an environmental impact, will be subject to approval by the Contracting Officer and may require an extended review, processing, and approval time. The Contracting Officer reserves the right to disapprove alternate methods, even if they are more cost effective, if the Contracting Officer determines that the proposed alternate method will have an adverse environmental impact.

## 1.9 NOTIFICATION

The Contracting Officer will notify the Contractor in writing of observed noncompliance with Federal, State or local environmental laws or regulations, permits, and other elements of the Contractor's Environmental Protection plan. After receipt of such notice, the Contractor shall inform the Contracting Officer of the proposed corrective action and take such action when approved by the Contracting Officer. The Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No time extensions will be granted or equitable adjustments allowed for such suspensions. This is in addition to other actions the Contracting Officer may take under the contract, or in accordance with the Federal Acquisition Regulation or Federal Law.

# PART 2 PRODUCTS

## 2.1 OBJECTIVE

Government procurement policy is to acquire goods and services through the use of sustainable environmental practices, including acquisition of biobased content/material, environmentally preferable, energy-efficient, water-efficient, recycled-content, and non-ozone depleting or are non-toxic or less toxic alternatives where such products and services meet agency performance requirements.

## 2.2 SUSTAINABLE ACQUISITION

The Contractor shall consider products that have a lesser or reduced adverse effect on human health and the environment, and provide products and materials with the least effect on the environment, determined by

life-cycle cost analysis or other methods in accordance with [NPR 8530.1A](#) Affirmative Procurement Program and Plan for Environmentally Preferable Products. These comparisons shall consider raw materials acquisition, production, manufacturing, packaging, distribution, reuse, operation, maintenance and disposal of products.

The Contractor shall ensure that products and materials being purchased comply, to the greatest extent practicable, with specific requirements regarding environmental attributes. These attributes include:

- a. EPA's CPG and recommendations concerning EPA's list of designated products listed in [40 CFR 247](#).
- b. Biobased products as defined by the United States Department of Agriculture.
- c. Energy-efficiency requirements regarding Energy Star.

#### 2.2.1 Prohibited Materials

The use of the following materials is prohibited:

- a. Products containing asbestos
- b. Products containing urea formaldehyde
- c. Products containing polychlorinated biphenyls
- d. Products containing chlorinated fluorocarbons
- e. Solder or flux containing more than 0.2 percent lead and domestic water pipe or pipe fittings containing more than 8 percent lead
- f. Paint containing more than 0.06 percent lead

#### 2.2.2 EPA Designated Items Incorporated in the Work

Various sections of the specifications contain requirements for materials that have been designated by EPA in [40 CFR 247](#) as being products which are or can be made with recovered or recycled materials. These items, when incorporated into the work under this contract, shall contain at least the specified percentage of recycled or recovered materials unless adequate justification (non-availability) for non-use is provided. When a designated item is specified as an option to a non-designated item, the designated item requirements apply only if the designated item is used in the work.

Many products listed in [40 CFR 247](#) have been designated or proposed by EPA to include recycled or recovered materials that may be used by the Contractor in performing the work but will not be incorporated into the work. These products include office products, temporary traffic control products, and pallets. It is recommended that these non-construction products, when used in the conduct of the work, contain the highest practicable percentage of recycled or recovered materials and that these products be recycled when no longer needed.

#### 2.2.3 Waiver

Procurement of EPA-designated (CPG) materials which do not meet the minimum recovered material standards require a waiver, approved by the Environmental Manager. A request for Waiver Form (KSC 28-825 NS) must be submitted for the purchase of items that are on the CPG list but are replaced with items that do not meet minimum standards.

### PART 3 EXECUTION

#### 3.1 LAND RESOURCES

Confine activities to areas defined by the drawings and specifications.

Identify land resources to be preserved within the work area prior to the beginning of construction. Do not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, and land forms without approval, except in areas indicated on the drawings or specified to be cleared. Ropes, cables, or guys will not be fastened to or attached to trees for anchorage unless specifically authorized. Provide effective protection for land and vegetation resources, as defined in the following subparagraphs. Remove stone, soil, or other materials displaced into uncleared areas.

#### 3.1.1 Work Area Limits

Mark the areas that need not be disturbed under this contract prior to commencing construction activities. Mark or fence isolated areas within the general work area which are not to be disturbed. Protect monuments and markers before construction operations commence. Where construction operations are to be conducted during darkness, markers must be visible in the dark. The Contractor's personnel must be knowledgeable of the purpose for marking and protecting particular objects.

#### 3.1.2 Landscape

Trees, shrubs, vines, grasses, land forms and other landscape features indicated and defined on the drawings to be preserved must be clearly identified by marking, fencing, or wrapping with boards, or other approved techniques. Restore landscape features damaged or destroyed during construction operations outside the limits of the approved work area.

#### 3.1.3 Erosion and Sediment Controls

The Contractor shall be responsible for providing erosion and sediment control measures in accordance with Federal, State, and local laws and regulations is the Contractor's responsibility. Select and maintain the erosion and sediment controls such that water quality standards are not violated as a result of construction activities. The area of bare soil exposed by construction operations should be kept to a minimum. The Contractor shall construct or install temporary and permanent erosion and sediment control best management practices (BMPs). BMPs may include, but not be limited to, vegetation cover, stream bank stabilization, slope stabilization, silt fences, construction of terraces, interceptor channels, sediment traps, inlet and outfall protection, diversion channels, and sedimentation basins. The Contractor's best management practices must also be in accordance with the National Pollutant Discharge Elimination System (NPDES) Storm Water Pollution Prevention Plan (SWPPP) which may be reviewed at the NASA Environmental Assurance Branch. Remove temporary measures after the area has been stabilized.

#### 3.1.4 Contractor Facilities and Work Areas

Place field offices, staging areas, stockpile storage, and temporary buildings in areas designated on the drawings or as directed by the Contracting Officer. Temporary movement or relocation of Contractor facilities will be made only when approved.

### 3.2 WATER RESOURCES

Monitor all water areas affected by construction activities to prevent pollution of surface and ground waters. Do not apply toxic or hazardous chemicals to soil or vegetation.

### 3.2.1 Wetlands

Do not enter, disturb, destroy, or allow discharge of contaminants into wetlands.

## 3.3 AIR RESOURCES

Equipment operation, activities, or processes shall be in accordance with Federal and State air emission and performance laws and standards.

### 3.3.1 Particulates

Dust particles; aerosols and gaseous by-products from construction activities; and processing and preparation of materials must be controlled at all times, including weekends, holidays and hours when work is not in progress. Maintain work areas within or outside the project boundaries free from particulates which would cause the Federal, State, and local air pollution standards to be exceeded or which would cause a hazard or a nuisance. Perform particulate control as the work proceeds and whenever a particulate nuisance or hazard occurs. Comply with State and local visibility regulations.

### 3.3.2 Burning

Burning is prohibited on the Government premises.

## 3.4 CHEMICAL MATERIALS MANAGEMENT AND WASTE DISPOSAL

Contractor shall develop and maintain procedures, instructions, and reports to be used in the event of an unforeseen spill of a substance regulated by 40 CFR 68, 40 CFR 302, 40 CFR 355, and/or regulated under State or local laws and regulations (e.g. Chapter 62-770, F.A.C.). The procedures, instructions, and reports shall supplement the requirements of KNPR 8500.1, Rev. B, KSC Requirements. At a minimum, the Contractor shall:

- (1) Identify the individual who will report any spills, or hazardous substance releases and who will follow up with complete documentation. This individual will immediately notify the Contracting Officer and the Environmental Assurance Branch in addition to the legally required Federal, State, and local reporting channels (including the National Response Center at 1-800-424-8802) if the reportable quantity is released to the environment. Provide a list of the required reporting channels and telephone numbers.
- (2) Identify the individual (including qualifications) who will be responsible for the implementing and supervising spill containment and cleanup.
- (3) Identify training requirements including the name(s) and qualifications of individuals responsible for training Contractor personnel. Include a description of the methods to accomplish the training requirements.
- (4) Identify the materials and equipment to be immediately available at the job site, tailored to contain and cleanup identified spill hazards.
- (5) Identify the names and locations of suppliers of containment materials and locations of additional fuel recovery, cleanup, restoration, and material-placement equipment available in the event of an unforeseen spill emergency.
- (6) Identify methods and procedures to be used for expeditious contaminant containment cleanup.



Contractor shall develop and maintain procedures to assure dust, debris, materials, trash, etc. do not become airborne and travel off the project site.

Contractor shall identify potentially hazardous substances to be used on the job site; identify the intended actions to prevent introduction of such materials into the air, water, or ground; and detail provisions for compliance with Federal, State, and local laws and regulations for storage and handling of identified potentially hazardous substances. In support of KNPR 8500.1, Rev. B, KSC Requirements, copies of Material Safety Data Sheets (MSDS) and the maximum quantities of each hazardous material to be onsite at any given time must be maintained onsite.

Disposal of wastes will be as directed below, unless otherwise specified in other sections or shown on the drawings.

#### 3.4.1 Solid Wastes

Solid wastes (excluding clearing debris) shall be placed in containers which are emptied on a regular schedule. Handling, storage, and disposal must be conducted to prevent contamination. Employ segregation measures so that no hazardous or toxic waste will become co-mingled with solid waste.

Waste items not requiring special handling, or which cannot be resold or recycled, shall be disposed of in receptacles slated for disposal in either the KSC landfill or the Brevard County landfill. The physical dimensions of the waste shall be within the handling capabilities of the landfill disposal equipment. The physical dimensions for the landfill handling capabilities are 8 feet in length x 8 feet in width.

The KSC landfill is an unlined Class III landfill with permit restrictions and limited capacity. The landfill is opened Tuesdays and Thursdays between 7:30am to 11:00am and 12:00pm to 3:00pm. Only the following items listed will be accepted at the landfill:

- (1) Asphalt: Asphalt removed from parking lots, driveways and roadways.
- (2) Blast Media: The blast media must be as free from debris as possible and determined non-hazardous for acceptance into the KSC landfill. The Spent Sandblast Media Disposal Form must accompany the blast media to the landfill and will be reviewed by the landfill operator. Blasting media determined to be hazardous waste must be managed as hazardous waste.
- (3) Carpeting: Carpet may be disposed of in the KSC landfill.
- (4) Construction and Demolition Debris: Materials considered not water soluble and non-hazardous in nature, including but not limited to steel, brick, glass, concrete, asphalt, pipe, gypsum wallboard and lumber. This includes rocks, soils, tree remains and other vegetative matter, which normally results from land clearing or development. Scrap metal from demolition projects should be managed according to guidance provided in this section for recyclable material.
- (5) Fiberglass: Fiberglass is accepted.
- (6) Glass (except for Light Bulbs or Lamps): Glass is accepted.

(7) Non-Friable Asbestos: Also referred to as Non-Regulated Asbestos Containing Materials (NRACM) are handled on a case-by-case basis. KSC policy allows for the disposal of NRACM only. In order to dispose of non-friable asbestos, the Contractor shall complete and submit the KSC/Schwartz Road Landfill Non-Friable Asbestos Form 28-1024, which can be obtained from the Contracting Officer or the Contracting Officer's designee. The form shall be sent to NASA EAB, TA-BIB through the Contracting Officer.

The following scheduling procedures shall be followed before NRACM wastes are accepted at the landfill:

- a. The waste generator/hauler shall make arrangements with the landfill operator a minimum of 24 hours before disposal of NRACM waste and shall inform the operator of the quantity of the waste and the scheduled date the shipment will arrive at the landfill.
- b. NRACM will be accepted at the landfill with prior arrangement with the scale house attendant (minimum of 24 hours notification) Tuesdays or Thursdays during regular landfill hours, but will not be accepted later than 1400 hours.

(8) Pallets (Unserviceable Wood and Plastics): Pallets that are not reusable or recycled are accepted.

(9) Wood: Miscellaneous non-pressure treated wood items are accepted.

(10) Yard Waste (Vegetation): Vegetation from maintenance activities is accepted.

The following wastes are not authorized for disposal at the KSC landfill:

- (1) Any waste not permitted by DEP regulations to be disposed of in a Class III landfill as defined in Rule 62-701.200(14) FAC.
- (2) Putrescible (brown bag) office waste.
- (3) Chromated Copper Arsenate (CCA) treated wood.
- (4) Liquid or non-liquid polychlorinated biphenyls (PCBs) (with exception of PCB Bulk Product Waste).
- (5) Friable Asbestos.
- (6) Hazardous wastes as specified by the U.S. Environmental Protection Agency (EPA); EPA defines hazardous waste as those wastes that exhibit flammability, corrosivity, reactivity, and/or toxicity characteristics; (Per EPA's list of hazardous wastes, 40 CFR 261, Subpart D, and most recent revision thereof).
- (7) Biomedical waste.
- (8) Liquid wastes, including oil (containerized or non-containerized).
- (9) Lead-acid batteries.
- (10) Tires, other than "shredded waste tires".

(11) White goods (i.e. appliances).

(12) Unpainted Concrete: Unpainted concrete shall be stockpiled at the Diverted Aggregate Recycling and Collection Yard (DARCY) located at the KSC landfill.

### 3.4.2 Chemicals and Chemical Wastes

Dispense chemicals ensuring no spillage to the ground or water. Perform and document periodic inspections of dispensing areas to identify leakage and initiate corrective action. This documentation will be periodically reviewed by the Government. Collect chemical waste in corrosion resistant, compatible containers. Collection drums must be monitored and removed to a staging or storage area when contents are within 6 inches of the top. Wastes shall be classified, managed, stored, and disposed of in accordance with KNPR 8500.1 KSC Environmental Requirements as well as Federal, State, and local laws and regulations.

### 3.4.3 Contractor Generated Hazardous Wastes/Excess Hazardous Materials

Hazardous and controlled waste shall be managed in accordance with all applicable statutes, rules, orders, and regulations which may include but are not limited to 40 CFR 260, 40 CFR 261, 40 CFR 262, 40 CFR 273, 40 CFR 279, 40 CFR 761, and KNPR 8500.1 KSC Environmental Requirements. Inorganic Zinc (IOZ) paint waste shall be separated from all other hazardous and controlled wastes and managed in accordance with KNPR 8500.1, Rev. B and the associated KSC Environmental Fact Sheet. In no case shall the Contractor or the Contractor's representative transport hazardous waste from KSC.

The Contractor shall be responsible for identifying processes and operations and the location and nature of all potentially hazardous and controlled waste including chemicals, paints, removed paints and coatings, solvents, aerosol cans, petroleum, oil and lubricant (POL) products, lamps, mercury switches, etc. and their containers, as defined in 40 CFR 261, 40 CFR 273, 40 CFR 279, or 40 CFR 761. The Contractor shall prepare copies of Material Safety Data Sheets (MSDS) and a completed KSC Form 25-551 "Process Waste Questionnaire" (PWQ) for each material which may be generated as a waste and provide these to the Contracting Officer (CO) thirty (30) days before the start of the waste generation process. No substances shall be delivered to KSC without the appropriate Material Safety Data Sheets.

The Contractor shall obtain a Technical Response Package (TRP) from the CO within thirty (30) days after receipt of the PWQ. The TRP will contain a hazard determination and analytical, packaging, labeling, and disposal requirements according to KNPR 8500.1 (as revised) and will provide site-specific waste management requirements to be followed by the Contractor.

The Government will provide DOT-compliant storage containers and labels. The CO will arrange for the containers to be available at the KSC Supply Building, M6-744, at the request of the Contractor. The Contractor shall request storage containers in writing from the CO a minimum of three (3) days before the required need date. The Contractor shall be responsible for transporting the containers from Building M6-744 to the project site. The Contractor shall establish an on-site satellite waste accumulation area within 50 feet (ft) of and within sight of any point where hazardous or controlled wastes may be generated. If a satellite accumulation area must

be more than 50 ft from the point of generation, or out of sight of the generator, the Contractor shall provide a written request to the CO thirty (30) days before the start of the waste generating process. The CO will send a notification to the NASA Environmental Assurance Branch (EAB), TA-A4B, for their review and concurrence. The Contractor shall not place the satellite site in service before receiving written approval of the variance. The Contractor shall store potential or identified hazardous and/or controlled wastes in the appropriate properly labeled containers inside the accumulation area in accordance with **KNPR 8500.1**, Rev. B (as revised).

The Environmental Protection Agency (EPA) has set the following standards for wastes collected at satellite accumulation areas:

- a. Hazardous wastes at satellite accumulation areas must be collected in approved containers.
- b. No more than 55 gallons per waste stream of hazardous waste or 1 quart per stream of acutely hazardous wastes may be accumulated.
- c. Containers must be labeled with the words "Hazardous Waste" and with other words which identify the contents of the drum.
- d. The waste being placed in the container must be compatible with the container.
- e. A container holding hazardous waste must be always be kept closed during accumulation except when adding or removing waste.
- f. The site must be equipped with emergency equipment per 40 CFR 265.32.
- g. A written contingency plan must be maintained for the site.
- h. Personnel generating and managing the waste must have hazardous waste training per **40 CFR 265.16**. The Contracting Officer may be any time during the course of the contract performance period require the Contractor to provide individual training records for any employee involved in the performance of this contract, and the contents of the course of courses completed to satisfy the training requirements. Attendance at KSC Training Course QG-211 "Hazardous Waste Management" will satisfy the above training requirements.

If more than 55 gallons per waste stream of hazardous waste are generated at a satellite accumulation site, documentation, including the waste type, quantity, locations and organization responsible for the waste shall be provided on KSC Form 28-809 "Waste Support Request", to the Contracting Officer Waste Management. The Contractor shall fax the waste support request to the Contracting Officer and KSC Waste Management at fax 867-9390.

If a hazardous/non-hazardous waste determination cannot be made by process knowledge and no MSDS is available for the waste stream, the container of waste shall be marked with a Hazardous Waste Determination In Progress (HWDIP) label until chemical analysis is completed. At the request of the Contractor, the CO will provide any analytical support required by the TRP. The CO will arrange for all sampling and testing of potentially hazardous or controlled waste.

Universal Waste (UW) - The EPA established Universal Waste regulations

to ease the requirements for managing hazardous wastes that can be recycled. Items which meet the definition of UW can be collected and managed under requirements found in 40 CFR 273 and Chapter 62-730 and Chapter 62-737, FAC. Waste streams currently adopted by the State for management as UW are batteries, mercury-containing lamps and devices, and certain pesticides.

UW generators are called handlers and must comply with the following requirements:

- a. Handlers shall manage UW using the PWQ/TRP.
- b. Handlers shall manage UW in a way that prevents releases to the environment. Non-leaking containers in good condition shall be used if the UW is damaged or leaking.
- c. Handlers shall use the KSC Universal Waste Label and shall not accumulate universal wastes for more than six months.
- d. Handlers shall clearly show the length of time that the wastes have been accumulated by marking or labeling the container with the earliest date that the waste was generated or received.
- e. Handlers shall be familiar with proper waste handling and emergency response procedures. Attendance at the KSC training course QG-299 "Universal Waste Rule" will satisfy the above.

Used Oil - Any lubricant that has been refined from crude oil (or synthetic oil) that has been "used", and as a result of such use is contaminated by physical or chemical impurities shall be considered Used Oil. Used oil is managed according to regulations established in 40 CFR 279 and Chapter 62-710, FAC. The following waste generator standards shall apply to the management of used oil:

- a. Used oil containers, tanks and associated piping must be marked "Used Oil".
- b. Used oil containers, tanks and associated piping must be in good condition with no severe rusting, structural defects, deterioration, or leaks.
- c. Used oil containers must be kept in secondary containment.
- d. Containers storing used oil must be sealed or otherwise protected from the weather and stored on an oil-impermeable surface such as polyethylene sheeting, rigid plastic secondary containment, or epoxy-coated concrete.

Within 48 hours of having waste ready for disposal, the Contractor shall contact the CO to have KSC Waste Management pick-up and remove hazardous waste. Documentation including the waste type, quantity, locations, and organization responsible for the waste will be provided on KSC Form 28-809 "Waste Support Request" to KSC Waste Management when requesting waste disposal. The Contractor shall fax the waste support request to the Contracting Officer and to KSC Waste Management at fax 867-9390.

#### 3.4.4 Fuel and Lubricants

Storage, fueling and lubrication of equipment and motor vehicles must be conducted in a manner that affords the maximum protection against spill and evaporation. Manage and store fuel, lubricants and oil in accordance with Federal, State, Regional, and local laws and regulations.

#### 3.4.5 Waste Water

Disposal of waste water will be as specified below.

- a. Waste water from construction activities, such as onsite material processing, concrete curing, foundation and concrete clean-up, water used in concrete trucks, forms, etc. will not be allowed to enter water ways or to be discharged prior to being treated to remove pollutants. Dispose of the construction related waste water off-Government property in accordance with Federal, State, Regional and Local laws and regulations.
- b. Water generated from the flushing of lines after disinfection or disinfection in conjunction with hydrostatic testing shall be discharged into the sanitary sewer with prior approval from the Institutional Services Contractor (ISC). To obtain approval, the Contractor shall submit a PWQ for the wastewater to IHA Waste Management..

### 3.5 RECYCLING AND WASTE MINIMIZATION

#### 3.5.1 Reuse

First consideration shall be given to salvage for reuse since little or no re-processing is necessary for this method, and less pollution is created when items are reused in their original form. Sale or donation of waste suitable for reuse shall be considered. Salvaged materials, other than those specified in other sections to be salvaged and reinstalled, shall not be used in this project.

#### 3.5.2 Recycle

Waste materials not suitable for reuse, but having value as being recyclable, shall be made available for recycling whenever economically feasible. For additional information, please contact the NASA/KSC Recycling Manager.

The Contractor shall participate in State and local government sponsored recycling programs. The Contractor is further encouraged to minimize solid waste generation throughout the duration of the project in accordance with environmental contract clause, Article J-8-21. Concrete that can be recycled shall be sent to the DARC. The DARC can accept unpainted concrete (free of staining) without analytical testing. DARC can also accept painted or coated concrete as long as one of the three conditions below is met:

- Total Metal and PCB laboratory analytical results do not exceed the Florida Department of Environmental Protection (FDEP) Soil Cleanup Target Levels, Residential, as referenced in Table II of Chapter 62-777 Florida Administrative Code.
- Paint and coating MSDS indicate products do not contain heavy metals or PCBs.
- Total PCB concentration is less than 50 ppm and the paint/coating is completely removed from the concrete.

The contractor shall manage recyclable concrete in accordance with **KNPR 8500.1** Rev. B and the DARC Fact Sheet.

### 3.6 NON-HAZARDOUS SOLID WASTE DIVERSION REPORT

The Contractor shall maintain an inventory of non-hazardous solid waste diversion and disposal of construction and demolition debris.

Non-hazardous Solid Waste Diversion Reports shall be submitted using KSC Form 7-648NS (Rev. 12/08) to the Contracting Officer by December 31 of each year or the closeout of the project, whichever comes first. Include the following in the report:

- a. Construction and Demolition (C&D) Debris Disposed = \_\_\_\_\_ in cubic yards or tons, as appropriate.
- b. Construction and Demolition (C&D) Debris Recycled = \_\_\_\_\_ in cubic yards or tons, as appropriate.
- c. Total C&D Debris Generated = \_\_\_\_\_ in cubic yards or tons, as appropriate.
- d. Waste Sent to Waste-To-Energy Incineration Plant (This amount should not be included in the recycled amount) = \_\_\_\_\_ in cubic yards or tons, as appropriate.

### 3.7 BIOLOGICAL RESOURCES

Minimize interference with, disturbance to, and damage to fish, wildlife, and plants including their habitat. The protection of threatened and endangered animal and plant species, including their habitat, is the Contractor's responsibility in accordance with Federal, State, Regional, and local laws and regulations.

### 3.8 TRAINING OF CONTRACTOR PERSONNEL

The Contractor's personnel must be trained in environmental protection and pollution control. Conduct environmental protection/pollution control meetings for personnel prior to commencing construction activities. Additional meetings must be conducted for new personnel and when site conditions change. Include in the training and meeting agenda: methods of detecting and avoiding pollution; familiarization with statutory and contractual pollution standards; installation and care of devices, vegetative covers, and instruments required for monitoring purposes to ensure adequate and continuous environmental protection/pollution control; anticipated hazardous or toxic chemicals or wastes, and other regulated contaminants; recognition and protection of archaeological sites, artifacts, wetlands, and endangered species and their habitat that are known to be in the area.

### 3.9 MONITORING WELLS

The Contractor shall locate monitoring wells at or adjacent to the project site during the preconstruction survey described in 1.7 of this Section. The Contractor shall protect and prevent the disturbance of these monitoring wells during construction. Disturbance or destruction of any monitoring well during construction shall be replaced at the Contractor's expense. Monitoring wells shall be replaced in accordance with the St. Johns River Water Management District, the Florida Department of Environmental Protection and the Contracting Officer's procedures and requirements.

### 3.10 POST CONSTRUCTION CLEANUP

The Contractor will clean up areas used for construction in accordance with Contract Clause: "Cleaning Up". Unless otherwise instructed in writing by the Contracting Officer, obliterate signs of temporary construction

facilities such as haul roads, work area, structures, foundations of temporary structures, stockpiles of excess or waste materials, and other vestiges of construction prior to final acceptance of the work. The disturbed area must be graded, filled and the entire area seeded unless otherwise indicated.

-- End of Section --



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## SECTION 01 78 23

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## SECTION 01 78 23

## OPERATION AND MAINTENANCE DATA

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## ASTM INTERNATIONAL (ASTM)

## ASTM E1971

(2005; R 2011) Stewardship for the  
Cleaning of Commercial and Institutional  
Buildings

## 1.2 SUBMISSION OF OPERATION AND MAINTENANCE DATA

Submit Operation and Maintenance (O&M) Data specifically applicable to this contract and a complete and concise depiction of the provided equipment, product, or system, stressing and enhancing the importance of system interactions, troubleshooting, and long-term preventative maintenance and operation. The subcontractors must compile and prepare data and deliver to the Contractor prior to the training of Government personnel. The Contractor must compile and prepare aggregate O&M data including clarifying and updating the original sequences of operation to as-built conditions. Organize and present information in sufficient detail to clearly explain O&M requirements at the system, equipment, component, and subassembly level. Include an index preceding each submittal. Submit in accordance with this section and Section 01 33 00 SUBMITTAL PROCEDURES.

## 1.2.1 Package Quality

Documents must be fully legible. Poor quality copies and material with hole punches obliterating the text or drawings will not be accepted.

## 1.2.2 Package Content

Data package content shall be as shown in the paragraph titled "Schedule of Operation and Maintenance Data Packages." Comply with the data package requirements specified in the individual technical sections, including the content of the packages and addressing each product, component, and system designated for data package submission, except as follows. Commissioned items without a specified data package requirement in the individual technical sections must use Data Package 5. Commissioned items with a Data Package 1 or 2 requirement must use instead Data Package 5.

## 1.2.3 Changes to Submittals

Manufacturer-originated changes or revisions to submitted data must be furnished by the Contractor if a component of an item is so affected subsequent to acceptance of the O&M Data. Submit changes, additions, or revisions required by the Contracting Officer for final acceptance of submitted data within 30 calendar days of the notification of this change

requirement.

#### 1.2.4 Review and Approval

The Government's Commissioning Authority (CA) must review the commissioned systems and equipment submittals for completeness and applicability. The Government must verify that the systems and equipment provided meet the requirements of the Contract documents and design intent, particularly as they relate to functionality, energy performance, water performance, maintainability, sustainability, system cost, indoor environmental quality, and local environmental impacts. This work is in addition to the normal review procedures for O&M data.

### 1.3 TYPES OF INFORMATION REQUIRED IN O&M DATA PACKAGES

#### 1.3.1 Operating Instructions

Include specific instructions, procedures, and illustrations for the following phases of operation for the installed model and features of each system:

##### 1.3.1.1 Safety Precautions

List personnel hazards and equipment or product safety precautions for all operating conditions.

##### 1.3.1.2 Operator Prestart

Include procedures required to install, set up, and prepare each system for use.

##### 1.3.1.3 Startup, Shutdown, and Post-Shutdown Procedures

Provide narrative description for Startup, Shutdown and Post-shutdown operating procedures including the control sequence for each procedure.

##### 1.3.1.4 Normal Operations

Provide narrative description of Normal Operating Procedures. Include Control Diagrams with data to explain operation and control of systems and specific equipment.

##### 1.3.1.5 Emergency Operations

Include Emergency Procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Include Emergency Shutdown Instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance and procedures for emergency operation of all utility systems including required valve positions, valve locations and zones or portions of systems controlled.

##### 1.3.1.6 Operator Service Requirements

Include instructions for services to be performed by the operator such as lubrication, adjustment, inspection, and recording gage readings.

#### 1.3.1.7 Environmental Conditions

Include a list of Environmental Conditions (temperature, humidity, and other relevant data) that are best suited for the operation of each product, component or system. Describe conditions under which the item equipment should not be allowed to run.

#### 1.3.2 Preventive Maintenance

Include the following information for preventive and scheduled maintenance to minimize corrective maintenance and repair for the installed model and features of each system. Include potential environmental and indoor air quality impacts of recommended maintenance procedures and materials.

##### 1.3.2.1 Lubrication Data

Include preventative maintenance lubrication data, in addition to instructions for lubrication provided under paragraph titled "Operator Service Requirements":

- a. A table showing recommended lubricants for specific temperature ranges and applications.
- b. Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities.
- c. A Lubrication Schedule showing service interval frequency.

##### 1.3.2.2 Preventive Maintenance Plan and Schedule

Include manufacturer's schedule for routine preventive maintenance, inspections, tests and adjustments required to ensure proper and economical operation and to minimize corrective maintenance. Provide manufacturer's projection of preventive maintenance work-hours on a daily, weekly, monthly, and annual basis including craft requirements by type of craft. For periodic calibrations, provide manufacturer's specified frequency and procedures for each separate operation.

##### 1.3.2.3 Cleaning Recommendations

Provide environmentally preferable cleaning recommendations in accordance with ASTM E1971.

#### 1.3.3 Corrective Maintenance (Repair)

Include manufacturer's recommended procedures and instructions for correcting problems and making repairs for the installed model and features of each system. Include potential environmental and indoor air quality impacts of recommended maintenance procedures and materials.

##### 1.3.3.1 Troubleshooting Guides and Diagnostic Techniques

Include step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.

#### 1.3.3.2 Wiring Diagrams and Control Diagrams

Wiring diagrams and control diagrams shall be point-to-point drawings of wiring and control circuits including factory-field interfaces. Provide a complete and accurate depiction of the actual job specific wiring and control work. On diagrams, number electrical and electronic wiring and pneumatic control tubing and the terminals for each type, identically to actual installation configuration and numbering.

#### 1.3.3.3 Maintenance and Repair Procedures

Include instructions and a list of tools required to repair or restore the product or equipment to proper condition or operating standards.

#### 1.3.3.4 Removal and Replacement Instructions

Include step-by-step procedures and a list required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings and adjustments required. Instructions shall include a combination of text and illustrations.

#### 1.3.3.5 Spare Parts and Supply Lists

Include lists of spare parts and supplies required for maintenance and repair to ensure continued service or operation without unreasonable delays. Special consideration is required for facilities at remote locations. List spare parts and supplies that have a long lead-time to obtain.

#### 1.3.4 Appendices

Provide information required below and information not specified in the preceding paragraphs but pertinent to the maintenance or operation of the product or equipment. Include the following:

##### 1.3.4.1 Product Submittal Data

Provide a copy of all SD-03 Product Data submittals required in the applicable technical sections.

##### 1.3.4.2 Manufacturer's Instructions

Provide a copy of all SD-08 Manufacturer's Instructions submittals required in the applicable technical sections.

##### 1.3.4.3 O&M Submittal Data

Provide a copy of all SD-10 Operation and Maintenance Data submittals required in the applicable technical sections.

##### 1.3.4.4 Parts Identification

Provide identification and coverage for all parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and

exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations and separate listing shall show the index, reference, or key number that will cross-reference the illustrated part to the listed part. Parts shown in the listings shall be grouped by components, assemblies, and subassemblies in accordance with the manufacturer's standard practice. Parts data may cover more than one model or series of equipment, components, assemblies, subassemblies, attachments, or accessories, such as typically shown in a master parts catalog

#### 1.3.4.5 Warranty Information

List and explain the various warranties and clearly identify the servicing and technical precautions prescribed by the manufacturers or contract documents in order to keep warranties in force. Include warranty information for primary components such as the compressor of air conditioning system.

#### 1.3.4.6 Personnel Training Requirements

Provide information available from the manufacturers that is needed for use in training designated personnel to properly operate and maintain the equipment and systems. See requirements described in Section 41 22 23.19, paragraph 3.5.

#### 1.3.4.7 Testing Equipment and Special Tool Information

Include information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components.

#### 1.3.4.8 Testing and Performance Data

Include completed prefunctional checklists, functional performance test forms, and monitoring reports. Include recommended schedule for retesting and blank test forms.

#### 1.3.4.9 Contractor Information

Provide a list that includes the name, address, and telephone number of the General Contractor and each Subcontractor who installed the product or equipment, or system. For each item, also provide the name address and telephone number of the manufacturer's representative and service organization that can provide replacements most convenient to the project site. Provide the name, address, and telephone number of the product, equipment, and system manufacturers.

### 1.4 TYPES OF INFORMATION REQUIRED IN CONTROLS O&M DATA PACKAGES

Include Data Package 5 and the following for control systems:

- a. Narrative description on how to perform and apply all functions, features, modes, and other operations, including unoccupied operation, seasonal changeover, manual operation, and alarms. Include detailed technical manual for programming and customizing control loops and algorithms.
- b. Full as-built sequence of operations.

- c. Copies of all checkout tests and calibrations performed by the Contractor.
- e. Full print out of all schedules and set points after testing and acceptance of the system.
- f. Full as-built print out of software program.
- g. Electronic File:
  - (1) Assemble each manual into a composite electronically indexed file in PDF format. Provide HDD's, DVD's or CD's as appropriate, so that each one contains all maintenance and record files, and also the Project Record Documents and Training Videos, of the entire program for this facility.
  - (2) Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
  - (3) Link the index to separate files within the composite of files. Book mark maintenance and record files, that have a Table of Contents, according to the Table of Contents
- h. Marking of all system sensors and thermostats on the as-built floor plan and mechanical drawings with their control system designations.

#### 1.5 SCHEDULE OF OPERATION AND MAINTENANCE DATA PACKAGES

Furnish the O&M data packages specified in individual technical sections. The required information for each O&M data package is as follows:

##### 1.5.1 Data Package 5

- a. Safety precautions
- b. Operator prestart
- c. Start-up, shutdown, and post-shutdown procedures
- d. Normal operations
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## SECTION 02 41 00

## DEMOLITION

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI Guideline K (2009) Guideline for Containers for Recovered Non-Flammable Fluorocarbon Refrigerants

## AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 347 (2004; Errata 2008; Errata 2012) Guide to Formwork for Concrete

## AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE A10.6 (2006) Safety Requirements for Demolition Operations

## JOHN F. KENNEDY SPACE CENTER (KSC)

KNPR 8715.7 (Rev. A-1) KSC Construction Contractor Safety and Health Practices and Procedural Requirements

## U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 61 National Emission Standards for Hazardous Air Pollutants

40 CFR 82 Protection of Stratospheric Ozone

## 1.2 PROJECT DESCRIPTION

## 1.2.1 Demolition/Deconstruction Plan

Prepare a [Demolition Plan](#) and submit proposed demolition, and removal procedures for approval before work is started. Include in the plan procedures for careful removal and disposition of materials specified to be salvaged, coordination with other work in progress, a disconnection schedule of utility services, a detailed description of methods and equipment to be used for each operation and of the sequence of operations. Identify components and materials to be salvaged for reuse or recycling with reference to paragraph Existing Facilities to be Removed. Append tracking forms for all removed materials indicating type, quantities, condition, destination, and end use. Coordinate with Waste Management

Plan. Include statements affirming Contractor inspection of the existing roof deck and its suitability to perform as a safe working platform or if inspection reveals a safety hazard to workers, state provisions for securing the safety of the workers throughout the performance of the work. Provide procedures for safe conduct of the work in accordance with [KNPR 8715.7](#), Rev A-1. Plan shall be approved by Contracting Officer prior to work beginning.

#### 1.2.2 General Requirements

Do not begin demolition until authorization is received from the Contracting Officer. [The work of this section is to be performed in a manner that maximizes salvage and recycling of materials.](#) Remove rubbish and debris from the project site; do not allow accumulations inside or outside the buildings. The work includes demolition, salvage of identified items and materials, and removal of resulting rubbish and debris. Remove rubbish and debris from Government property daily, unless otherwise directed. Store materials that cannot be removed daily in areas specified by the Contracting Officer. In the interest of occupational safety and health, perform the work in accordance with [KNPR 8715.7](#), Rev. A-1.

#### 1.3 ITEMS TO REMAIN IN PLACE

Take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Government. Repair or replace damaged items as approved by the Contracting Officer. Coordinate the work of this section with all other work indicated. Construct and maintain shoring, bracing, and supports as required. Ensure that structural elements are not overloaded. Increase structural supports or add new supports as may be required as a result of any cutting, removal, deconstruction, or demolition work performed under this contract. Do not overload structural elements. Provide new supports and reinforcement for existing construction weakened by demolition, deconstruction, or removal work. Repairs, reinforcement, or structural replacement require approval by the Contracting Officer prior to performing such work.

##### 1.3.1 Existing Construction Limits and Protection

Do not disturb existing construction beyond the extent indicated or necessary for installation of new construction. Provide temporary shoring and bracing for support of building components to prevent settlement or other movement. Provide protective measures to control accumulation and migration of dust and dirt in all work areas. Remove dust, dirt, and debris from work areas daily.

##### 1.3.2 Weather Protection

For portions of the building to remain, protect building interior and materials and equipment from the weather at all times. Where removal of existing roofing is necessary to accomplish work, have materials and workmen ready to provide adequate and temporary covering of exposed areas.

##### 1.3.3 Utility Service

Maintain existing utilities indicated to stay in service and protect against damage during demolition and deconstruction operations. Prior to start of work, the Government will disconnect and seal utilities serving each area of alteration or removal upon written request from the Contractor.

#### 1.3.4 Facilities

Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities. Floors, roofs, walls, columns, pilasters, and other structural components that are designed and constructed to stand without lateral support or shoring, and are determined to be in stable condition, must remain standing without additional bracing, shoring, or lateral support until demolished or deconstructed, unless directed otherwise by the Contracting Officer. Ensure that no elements determined to be unstable are left unsupported and place and secure bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, deconstruction, or demolition work performed under this contract.

#### 1.4 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted.

#### 1.5 AVAILABILITY OF WORK AREAS

Areas in which the work is to be accomplished will be available in accordance with the following schedule:

Schedule	
Area	Date

#### 1.6 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

##### SD-01 Preconstruction Submittals

Existing Conditions; G

##### SD-07 Certificates

Demolition Plan; G

Notification; G

##### SD-11 Closeout Submittals

Receipts

#### 1.7 QUALITY ASSURANCE

Submit timely notification of demolition projects to Federal, State, regional, and local authorities in accordance with 40 CFR 61, Subpart M. Notify the the Contracting Officer in writing 10 working days prior to the commencement of work in accordance with 40 CFR 61, Subpart M. Comply with

federal, state, and local hauling and disposal regulations. In addition to the requirements of the "Contract Clauses," conform to the safety requirements contained in ASSE/SAFE A10.6. Comply with the Environmental Protection Agency requirements specified. Use of explosives will not be permitted.

#### 1.7.1 Dust and Debris Control

Prevent the spread of dust and debris to occupied portions of the building and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, ice, flooding, or pollution. Vacuum and dust the work area daily. Sweep pavements as often as necessary to control the spread of debris that may result in foreign object damage.

### 1.8 PROTECTION

#### 1.8.1 Protection of Personnel

Before, during and after the demolition work continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the project site. No area, section, or component of floors, roofs, walls, columns, pilasters, or other structural element will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.

The Contractor shall protect personnel from demolition activities impacting paints and coatings that contain hazardous metals and Polychlorinated Biphenyls (PCBs). Equipment, work practices and controls to prevent exposure to workers, adjacent unprotected personnel and the environment shall be described in the Hazardous Metal and PCB Compliance and Health and Safety Plan submitted in accordance with Section 02 83 13.00 20 Hazardous Metals and Polychlorinated Biphenyls (PCBs) in Construction. Establish and implement a respiratory protection program as required in accordance with Section 02 83 13.00 20 Hazardous Metals and Polychlorinated Biphenyls (PCBs) in Construction.

### 1.9 RELOCATIONS

Perform the removal and reinstallation of relocated items as indicated with workmen skilled in the trades involved. Repair or replace items to be relocated which are damaged by the Contractor with new undamaged items as approved by the Contracting Officer.

#### 1.10 EXISTING CONDITIONS

Before beginning any demolition or deconstruction work, survey the site and examine the drawings and specifications to determine the extent of the work. Record existing conditions in the presence of the Contracting Officer showing the condition of structures and other facilities adjacent to areas of alteration or removal. Photographs sized 4 inch will be acceptable as a record of existing conditions. Include in the record the elevation of the top of foundation walls, finish floor elevations, possible conflicting electrical conduits, plumbing lines, alarms systems, the location and extent of existing cracks and other damage and description of surface conditions that exist prior to before starting work. It is the Contractor's responsibility to verify and document all required outages which will be required during the course of work, and to note these outages

on the record document. Submit survey results.

## PART 2 PRODUCTS

NOT USED

## PART 3 EXECUTION

### 3.1 EXISTING FACILITIES TO BE REMOVED

Inspect and evaluate existing structures onsite for reuse. Existing construction scheduled to be removed for reuse shall be disassembled. Dismantled and removed materials are to be separated, set aside, and prepared as specified, and stored or delivered to a collection point for reuse, remanufacture, recycling, or other disposal, as specified. Materials shall be designated for reuse onsite whenever possible.

#### 3.1.1 Structures

- a. Remove existing structures indicated to be removed to grade. Interior walls, other than retaining walls and partitions, shall be removed to top of concrete slab on ground.
- b. Demolish Deconstruct structures in a systematic manner from the top of the structure to the ground. Complete demolition work above each tier or floor before the supporting members on the lower level are disturbed. Demolish concrete and masonry walls in small sections. Remove structural framing members and lower to ground by means of derricks, platforms hoists, or other suitable methods as approved by the Contracting Officer.
- c. Locate demolition and deconstruction equipment throughout the structure and remove materials so as to not impose excessive loads to supporting walls, floors, or framing.

#### 3.1.2 Utilities and Related Equipment

##### 3.1.2.1 General Requirements

Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by the Contracting Officer. Do not interrupt existing utilities serving facilities occupied and used by the Government except when approved in writing and then only after temporary utility services have been approved and provided. Do not begin demolition or deconstruction work until all utility disconnections have been made. Shut off and cap utilities for future use, as indicated.

##### 3.1.2.2 Disconnecting Existing Utilities

Remove existing utilities, as indicated and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the Contracting Officer. When utility lines are encountered but are not indicated on the drawings, notify the Contracting Officer prior to further work in that area. Remove meters and related equipment and deliver to a location in accordance with instructions of the Contracting Officer.



### 3.1.3 Chain Link Fencing

Remove chain link fencing, gates and other related salvaged items scheduled for removal and transport to designated areas. Remove gates as whole units. Cut chain link fabric to 25 foot lengths and store in rolls off the ground.

### 3.1.4 Paving and Slabs

Sawcut concrete and asphaltic concrete paving and slabs as indicated to a depth below grade. Provide neat sawcuts at limits of pavement removal as indicated. Pavement and slabs designated to be recycled and utilized in this project shall be moved, ground and stored as directed by the Contracting Officer. Pavement and slabs not to be used in this project shall be removed from the Installation at Contractor's expense.

### 3.1.5 Masonry

Sawcut and remove masonry so as to prevent damage to surfaces to remain, and to facilitate the installation of new work. Where new masonry adjoins existing, the new work shall abut or tie into the existing construction as indicated. Provide square, straight edges and corners where existing masonry adjoins new work and other locations.

### 3.1.6 Concrete

Saw concrete along straight lines to a depth of a minimum 2 inch. Make each cut in walls perpendicular to the face and in alignment with the cut in the opposite face. Break out the remainder of the concrete provided that the broken area is concealed in the finished work, and the remaining concrete is sound. At locations where the broken face cannot be concealed, grind smooth or saw cut entirely through the concrete.

### 3.1.7 Structural Steel

Dismantle structural steel at field connections and in a manner that will prevent bending or damage. Salvage for recycle structural steel, steel joists, girders, angles, plates, columns and shapes. Flame-cutting torches are permitted when other methods of dismantling are not practical. Transport steel joists and girders as whole units and not dismantled. Transport structural steel shapes to a designated storage area as directed by the Contracting Officer, stacked according to size, type of member and length, and stored off the ground, protected from the weather.

### 3.1.8 Miscellaneous Metal

Salvage shop-fabricated items such as access doors and frames, steel gratings, metal ladders, wire mesh partitions, metal railings, metal windows and similar items as whole units. Salvage light-gage and cold-formed metal framing, such as steel studs, steel trusses, metal gutters, roofing and siding, metal toilet partitions, toilet accessories and similar items. Recycle scrap metal as part of demolition and deconstruction operations. Provide separate containers to collect scrap metal and transport to a scrap metal collection or recycling facility, in accordance with the Waste Management Plan.

### 3.1.9 Patching

Where removals leave holes and damaged surfaces exposed in the finished

work, patch and repair these holes and damaged surfaces to match adjacent finished surfaces, using on-site materials when available. Where new work is to be applied to existing surfaces, perform removals and patching in a manner to produce surfaces suitable for receiving new work. Finished surfaces of patched area shall be flush with the adjacent existing surface and shall match the existing adjacent surface as closely as possible as to texture and finish. Provide a Class A finish per ACI 347-4 where equipment pads are removed. Patching shall be as specified and indicated, and shall include:

- a. Concrete and Masonry: Completely fill holes and depressions, left as a result of removals in existing masonry walls to remain, with an approved masonry patching material, applied in accordance with the manufacturer's printed instructions.
- b. Where existing partitions have been removed leaving damaged or missing resilient tile flooring, patch to match the existing floor tile.
- c. Patch acoustic lay-in ceiling where partitions have been removed. The transition between the different ceiling heights shall be effected by continuing the higher ceiling level over to the first runner on the lower ceiling and closing the vertical opening with a painted sheet metal strip.

#### 3.1.10 Air Conditioning Equipment

Remove air conditioning, refrigeration, and other equipment containing refrigerants without releasing chlorofluorocarbon refrigerants to the atmosphere in accordance with the Clean Air Act Amendment of 1990. Recover all refrigerants prior to removing air conditioning, refrigeration, and other equipment containing refrigerants and dispose of in accordance with the paragraph entitled "Disposal of Ozone Depleting Substance (ODS)." Turn in salvaged Class I ODS refrigerants as specified in paragraph, "Salvaged Materials and Equipment."

#### 3.1.11 Cylinders and Canisters

Remove all fire suppression system cylinders and canisters and dispose of in accordance with the paragraph entitled "Disposal of Ozone Depleting Substance (ODS)."

#### 3.1.12 Locksets on Swinging Doors

Remove all locksets from all swinging doors indicated to be removed and disposed of. Deliver the locksets and related items to a designated location for receipt by the Contracting Officer after removal.

#### 3.1.13 Mechanical Equipment and Fixtures

Disconnect mechanical hardware at the nearest connection to existing services to remain, unless otherwise noted. Disconnect mechanical equipment and fixtures at fittings. Remove service valves attached to the unit. Salvage each item of equipment and fixtures as a whole unit; listed, indexed, tagged, and stored. Salvage each unit with its normal operating auxiliary equipment. Transport salvaged equipment and fixtures, including motors and machines, to a designated storage area as directed by the Contracting Officer. Do not remove equipment until approved. Do not offer low-efficiency equipment for reuse; provide to recycling service for disassembly and recycling of parts.

#### 3.1.13.1 Preparation for Storage

Remove water, dirt, dust, and foreign matter from units; tanks, piping and fixtures shall be drained; interiors, if previously used to store flammable, explosive, or other dangerous liquids, shall be steam cleaned. Seal openings with caps, plates, or plugs. Secure motors attached by flexible connections to the unit. Change lubricating systems with the proper oil or grease.

#### 3.1.13.2 Piping

Disconnect piping at unions, flanges and valves, and fittings as required to reduce the pipe into straight lengths for practical storage. Store salvaged piping according to size and type. If the piping that remains can become pressurized due to upstream valve failure, end caps, blind flanges, or other types of plugs or fittings with a pressure gage and bleed valve shall be attached to the open end of the pipe to ensure positive leak control. Carefully dismantle piping that previously contained gas, gasoline, oil, or other dangerous fluids, with precautions taken to prevent injury to persons and property. Store piping outdoors until all fumes and residues are removed. Box prefabricated supports, hangers, plates, valves, and specialty items according to size and type. Wrap sprinkler heads individually in plastic bags before boxing. Classify piping not designated for salvage, or not reusable, as scrap metal.

#### 3.1.13.3 Ducts

Classify removed duct work as scrap metal.

#### 3.1.13.4 Fixtures, Motors and Machines

Remove and salvage fixtures, motors and machines associated with plumbing, heating, air conditioning, refrigeration, and other mechanical system installations. Salvage, box and store auxiliary units and accessories with the main motor and machines. Tag salvaged items for identification, storage, and protection from damage. Classify broken, damaged, or otherwise unserviceable units and not caused to be broken, damaged, or otherwise unserviceable as debris to be disposed of by the Contractor.

#### 3.1.14 Electrical Equipment and Fixtures

Salvage motors, motor controllers, and operating and control equipment that are attached to the driven equipment. Salvage wiring systems and components. Box loose items and tag for identification. Disconnect primary, secondary, control, communication, and signal circuits at the point of attachment to their distribution system.

##### 3.1.14.1 Fixtures

Remove and salvage electrical fixtures. Salvage unprotected glassware from the fixture and salvage separately. Salvage incandescent, mercury-vapor, and fluorescent lamps and fluorescent ballasts manufactured prior to 1978, boxed and tagged for identification, and protected from breakage.

##### 3.1.14.2 Electrical Devices

Remove and salvage switches, switchgear, transformers, conductors including wire and nonmetallic sheathed and flexible armored cable, regulators,

meters, instruments, plates, circuit breakers, panelboards, outlet boxes, and similar items. Box and tag these items for identification according to type and size.

#### 3.1.14.3 Wiring Ducts or Troughs

Remove and salvage wiring ducts or troughs. Dismantle plug-in ducts and wiring troughs into unit lengths. Remove plug-in or disconnecting devices from the busway and store separately.

#### 3.1.14.4 Conduit and Miscellaneous Items

Salvage conduit except where embedded in concrete or masonry. Consider corroded, bent, or damaged conduit as scrap metal. Sort straight and undamaged lengths of conduit according to size and type. Classify supports, knobs, tubes, cleats, and straps as debris to be removed and disposed.

#### 3.1.15 Elevators and Hoists

Remove elevators, hoists, and similar conveying equipment and salvage as whole units, to the most practical extent. Remove and prepare items for salvage without damage to any of the various parts. Salvage and store rails for structural steel with the equipment as an integral part of the unit.

#### 3.1.16 Items With Unique/Regulated Disposal Requirements

Remove and dispose of items with unique or regulated disposal requirements in the manner dictated by law or in the most environmentally responsible manner.

### 3.2 DISPOSITION OF MATERIAL

#### 3.2.1 Title to Materials

Except for salvaged items specified in related Sections, and for materials or equipment scheduled for salvage, all materials and equipment removed and not reused or salvaged, shall become the property of the Contractor and shall be removed from Government property. Title to materials resulting from demolition and deconstruction, and materials and equipment to be removed, is vested in the Contractor upon approval by the Contracting Officer of the Contractor's demolition, deconstruction, and removal procedures, and authorization by the Contracting Officer to begin demolition and deconstruction. The Government will not be responsible for the condition or loss of, or damage to, such property after contract award. Showing for sale or selling materials and equipment on site is prohibited.

#### 3.2.2 Reuse of Materials and Equipment

Remove and store materials and equipment listed in the Demolition to be reused or relocated to prevent damage, and reinstall as the work progresses.

#### 3.2.3 Salvaged Materials and Equipment

Remove materials and equipment that are listed in the Demolition Plan to be removed by the Contractor and that are to remain the property of the Government, and deliver to a storage site, as directed within 2 miles of

the work site.

- a. Salvage items and material to the maximum extent possible.
- b. Store all materials salvaged for the Contractor as approved by the Contracting Officer and remove from Government property before completion of the contract. On site sales of salvaged material is prohibited.
- c. Remove salvaged items to remain the property of the Government in a manner to prevent damage, and packed or crated to protect the items from damage while in storage or during shipment. Items damaged during removal or storage must be repaired or replaced to match existing items. Properly identify the contents of containers. .
- d. Remove the following items reserved as property of the using service prior to commencement of work under this contract: .
- e. Remove historical items in a manner to prevent damage. Deliver the following historical items to the Government for disposition: Corner stones, contents of corner stones, and document boxes wherever located on the site.
- f. Remove and capture all Class I ODS refrigerants in accordance with the Clean Air Act Amendment of 1990, and turn in to the Commanding Officer.

#### 3.2.4 Disposal of Ozone Depleting Substance (ODS)

Class I and Class II ODS are defined in Section, 602(a) and (b), of The Clean Air Act. Prevent discharge of Class I and Class II ODS to the atmosphere. Place recovered ODS in cylinders meeting [AHRI Guideline K](#) suitable for the type ODS (filled to no more than 80 percent capacity) and provide appropriate labeling. Recovered ODS shall be turned over to the Contracting Officer. Products, equipment and appliances containing ODS in a sealed, self-contained system (e.g. residential refrigerators and window air conditioners) shall be disposed of in accordance with [40 CFR 82](#). Submit [Receipts](#) or bills of lading, as specified. Submit a shipping receipt or bill of lading for all containers of ozone depleting substance (ODS) shipped to the Defense Depot, Richmond, Virginia.

##### 3.2.4.1 Special Instructions

No more than one type of ODS is permitted in each container. A warning/hazardous label shall be applied to the containers in accordance with Department of Transportation regulations. All cylinders including but not limited to fire extinguishers, spheres, or canisters containing an ODS shall have a tag with the following information:

- a. Activity name and unit identification code
- b. Activity point of contact and phone number
- c. Type of ODS and pounds of ODS contained
- d. Date of shipment

##### 3.2.4.2 Fire Suppression Containers

Deactivate fire suppression system cylinders and canisters with electrical

charges or initiators prior to shipment. Also, safety caps must be used to cover exposed actuation mechanisms and discharge ports on these special cylinders.

### 3.2.5 Unsalvageable and Non-Recyclable Material

Dispose of unsalvageable and non-recyclable noncombustible material in the disposal area located on the plans. The fill in the disposal area shall remain below elevation and after disposal is completed, the disposal area shall be uniformly graded to drain.

## 3.3 CLEANUP

Remove debris and rubbish from basement and similar excavations. Remove and transport the debris in a manner that prevents spillage on streets or adjacent areas. Apply local regulations regarding hauling and disposal.

## 3.4 DISPOSAL OF REMOVED MATERIALS

### 3.4.1 Regulation of Removed Materials

Dispose of debris, rubbish, scrap, and other nonsalvageable materials resulting from removal operations with all applicable federal, state and local regulations as contractually specified in the Waste Management Plan.

### 3.4.2 Burning on Government Property

Burning of materials removed from demolished structures will not be permitted on Government property.

### 3.4.3 Removal to Spoil Areas on Government Property

Transport noncombustible materials removed from demolition and deconstruction structures to designated spoil areas on Government property.

### 3.4.4 Removal from Government Property

Transport waste materials removed from demolished and deconstructed structures, except waste soil, from Government property for legal disposal. Dispose of waste soil as directed.

## 3.5 REUSE OF SALVAGED ITEMS

Recondition salvaged materials and equipment designated for reuse before installation. Replace items damaged during removal and salvage operations or restore them as necessary to usable condition.

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## SECTION 02 83 13.00 20

## HAZARDOUS METALS AND POLYCHLORINATED BIPHENYLS (PCBs) IN CONSTRUCTION

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## AMERICAN INDUSTRIAL HYGIENE ASSOCIATION (AIHA)

AIHA Z88.6 (2006) Respiratory Protection - Respirator Use-Physical Qualifications for Personnel

## JOHN F. KENNEDY SPACE CENTER (KSC)

KNPR 1840.19 (2011; Rev C-1) KSC Industrial Hygiene Programs

KNPR 8500.1 (2010; Rev B) KSC Environmental Requirements

## U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1926.103 Respiratory Protection

29 CFR 1926.1126 Chromium (VI)

29 CFR 1926.1127 Cadmium

29 CFR 1926.21 Safety Training and Education

29 CFR 1926.33 Access to Employee Exposure and Medical Records

29 CFR 1926.55 Gases, Vapors, Fumes, Dusts, and Mists

29 CFR 1926.59 Hazard Communication

29 CFR 1926.62 Lead

29 CFR 1926.65 Hazardous Waste Operations and Emergency Response

40 CFR 260 Hazardous Waste Management System: General

40 CFR 261 Identification and Listing of Hazardous Waste

40 CFR 262 Standards Applicable to Generators of Hazardous Waste

40 CFR 263 Standards Applicable to Transporters of Hazardous Waste

40 CFR 264	Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 265	Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 761	Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions
49 CFR 172	Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements
49 CFR 178	Specifications for Packagings

UNDERWRITERS LABORATORIES (UL)

UL 586	(2009) Standard for High-Efficiency Particulate, Air Filter Units
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## 1.2 DEFINITIONS

### 1.2.1 Action Level

Employee exposure, without regard to use of respirators, to an airborne concentration of lead of 30 micrograms per cubic meter of air averaged over an 8 hour period.

Employee exposure, without regard to use of respirators, to an airborne concentration of cadmium or chromium (VI) of 2.5 micrograms per cubic meter of air averaged over an 8 hour period.

### 1.2.2 Area Sampling

Sampling of hazardous metals and PCB concentrations within the control area and inside the physical boundaries which is representative of the airborne hazardous metals and PCB concentrations but is not collected in the breathing zone of personnel (approximately 5 to 6 feet above the floor).

### 1.2.3 Cadmium Permissible Exposure Limit (PEL)

Five micrograms per cubic meter of air as an 8 hour time-weighted average as determined by 29 CFR 1926.1127.

### 1.2.4 Chromium (VI) Permissible Exposure Limit (PEL)

Five micrograms per cubic meter of air as an 8 hour time weighted average as determined by 29 CFR 1926.1126.

### 1.2.5 Competent Person (CP)

As used in this section, refers to a person employed by the Contractor who is trained in the recognition and control of hazardous metals and PCB hazards in accordance with current Federal, State, and local regulations

and has the authority to take prompt corrective actions to control the hazard. A Certified Industrial Hygienist (CIH) certified by the American Board of Industrial Hygiene or a Certified Safety Professional (CSP) certified by the Board of Certified Safety Professionals is the best choice.

#### 1.2.6 Contaminated Room

Refers to a room for removal of contaminated personal protective equipment (PPE).

#### 1.2.7 Decontamination Shower Facility

A facility that encompasses a clean clothing storage room, and contaminated clothing storage and disposal rooms, with a shower facility in between.

#### 1.2.8 Hazardous Metal

Metals and metal compounds that negatively affect human health. Hazardous metal include but are not limited to lead, cadmium, chromium (VI) and mercury.

#### 1.2.9 High Efficiency Particulate Arrestor (HEPA) Filter Equipment

HEPA filtered vacuuming equipment with a [UL 586](#) filter system capable of collecting and retaining lead-contaminated particulate. A high efficiency particulate filter demonstrates at least 99.97 percent efficiency against 0.3 micron or larger size particles.

#### 1.2.10 Lead

Metallic lead, inorganic lead compounds, and organic lead soaps. Excludes other forms of organic lead compounds.

#### 1.2.11 Control Area

A system of control methods to prevent the spread of hazardous metals and PCB dust, paint chips or debris to adjacent areas that may include temporary containment, floor or ground cover protection, physical boundaries, and warning signs to prevent unauthorized entry of personnel. HEPA filtered local exhaust equipment may be used as engineering controls to further reduce personnel exposures or building/outdoor environmental contamination.

#### 1.2.12 Lead Permissible Exposure Limit (PEL)

Fifty micrograms per cubic meter of air as an 8 hour time weighted average as determined by [29 CFR 1926.62](#). If an employee is exposed for more than eight hours in a work day, the PEL shall be determined by the following formula:

$$\text{PEL (micrograms/cubic meter of air)} = 400/\text{No. hrs worked per day}$$

#### 1.2.13 Material Containing Lead/Paint with Lead (MCL/PWL)

Material, including paint, which contains lead as determined by the testing laboratory using a valid test method. The requirements of this section does not apply if no detectable levels of lead are found using a quantitative method for analyzing paint or MCL using laboratory instruments with specified limits of detection (usually 0.01 percent). An X-Ray

Fluorescence (XRF) instrument is not considered a valid test method.

#### 1.2.14 Mercury Permissible Exposure Limit (PEL)

0.1 milligrams per cubic meter of air as an 8 hour time weighted average as determined by 29 CFR 1926.55.

#### 1.2.15 PCB Permissible Exposure Limit (PEL)

Five hundred micrograms per cubic meter of air as an 8 hour time weighted average as identified in 29 CFR 1926.55.

#### 1.2.16 Personal Sampling

Sampling of airborne hazardous metal and PCB concentrations within the breathing zone of an employee to determine the 8 hour time weighted average concentration in accordance with 29 CFR 1926.62, 29 CFR 1926.55, 29 CFR 1926.1126 and 29 CFR 1926.1127. Samples shall be representative of the employees' work tasks. Breathing zone shall be considered an area within a hemisphere, forward of the shoulders, with a radius of 6 to 9 inches and centered at the nose or mouth of an employee.

#### 1.2.17 Physical Boundary

Area physically roped or partitioned off around lead control area to limit unauthorized entry of personnel.

### 1.3 DESCRIPTION

#### 1.3.1 Description of Work

Construction activities impacting PWL or material containing hazardous metals and PCBs which are covered by this specification include the demolition or removal of material containing hazardous metal and PCBs in paints and coatings, located on support structures in the Vehicle Assembly Building Highway 3 and as indicated on the drawings.

#### 1.3.2 Coordination with Other Work

The contractor shall coordinate with work being performed in adjacent areas. Coordination procedures shall be explained in the Plan and shall describe how the Contractor will prevent hazardous metal and PCB exposure to other contractors or Government personnel performing work unrelated to hazardous metal and PCB activities.

### 1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

#### SD-01 Preconstruction Submittals

Occupational and Environmental Assessment Data Report (if objective data is used to justify excluding the initial occupational exposure assessment); G

Hazardous Metal and PCB Compliance and Health and Safety Plan

including CP approval (signature, date, and certification number);  
G

Competent Person qualifications; G

Training Certification of workers and supervisors; G

Hazardous Metal and PCB Waste Management Plan; G

Certification of Medical Examinations; G

#### SD-06 Test Reports

Sampling results; G

Occupational and Environmental Assessment Data Report; G

#### SD-07 Certificates

Testing laboratory qualifications; G

Clearance Certification; G

### 1.5 QUALITY ASSURANCE

#### 1.5.1 Qualifications

##### 1.5.1.1 Competent Person (CP)

Submit name, address, and telephone number of the CP selected to perform responsibilities specified in paragraph entitled "Competent Person (CP) Responsibilities." Provide documented construction project-related experience with implementation of OSHA's Hazardous Metal and PCB in Construction standards (29 CFR 1926.62, 29 CFR 1926.55, 29 CFR 1926.1126 and 29 CFR 1926.1127) which shows ability to assess occupational and environmental exposure to Hazardous Metal and PCB, experience with the use of respirators, personal protective equipment and other exposure reduction methods to protect employee health. Submit proper documentation that the CP is trained and licensed or certified in accordance with Federal, State and local laws.

##### 1.5.1.2 Training Certification

Submit a certificate for each worker and supervisor, signed and dated by the training provider, stating that the employee has received the required training specified in 29 CFR 1926.62, 29 CFR 1926.1126 and 29 CFR 1926.1127 and is certified to perform or supervise hazardous metal removal or demolition activities.

##### 1.5.1.3 Testing Laboratory

Submit the name, address, and telephone number of the testing laboratory selected to perform the air and wipe analysis, testing, and reporting of airborne concentrations of hazardous metals and PCBs. Use a laboratory participating in the EPA National Lead Laboratory Accreditation Program (NLLAP) by being accredited by either the American Association for Laboratory Accreditation (A2LA) or the American Industrial Hygiene Association (AIHA) and that is successfully participating in the Environmental Lead Proficiency Analytical Testing

(ELPAT) program to perform sample analysis. Laboratories selected to perform blood analysis shall be OSHA approved.

#### 1.5.2 Requirements

##### 1.5.2.1 Competent Person (CP) Responsibilities

- a. Verify training meets all Federal, State, and local requirements.
- b. Review and approve Hazardous Metal and PCB Compliance and Health and Safety Plan for conformance to the applicable referenced standards.
- c. Continuously inspect hazardous metal and PCB work for conformance with the approved plan.
- d. Perform (or oversee performance of) air sampling. Recommend upgrades or downgrades (whichever is appropriate based on exposure) on the use of PPE (respirators included) and engineering controls.
- e. Ensure work is performed in strict accordance with specifications.
- f. Control work to prevent hazardous exposure to human beings and to the environment.
- g. Supervise final cleaning of the control area, take clearance wipe samples; review clearance sample results and make recommendations for further cleaning.
- h. Certify the conditions of the work as called for elsewhere in this specification.

##### 1.5.2.2 Hazardous Metal and PCB Compliance and Health and Safety Plan

Submit a detailed job-specific plan of the work procedures to be used in the disturbance of paint, coatings or materials containing hazardous metals or PCBs. The plan shall include a sketch showing the location, size, and details of control areas, critical barriers, physical boundaries, location and details of decontamination facilities, viewing ports, and mechanical ventilation system. Include a description of equipment and materials, work practices, controls and job responsibilities for each activity from which hazardous metals or PCBs are emitted. Include in the plan, eating, drinking, smoking, hygiene facilities and sanitary procedures, interface of trades, sequencing of hazardous metals and PCB related work, collected waste water and dust containing hazardous metals and PCB and debris, air sampling, respirators, personal protective equipment, and a detailed description of the method of containment of the operation to ensure that hazardous metals and PCB are not released outside of the control area. Include site preparation, cleanup and clearance procedures. Include occupational and environmental sampling, training and strategy, sampling and analysis, strategy and methodology, frequency of sampling, duration of sampling, and qualifications of sampling personnel in the air sampling portion of the plan. Include a description of arrangements made among contractors on multicontractor worksites to inform affected employees and to clarify responsibilities to control exposures.

Work may involve the disturbance of concrete, masonry and tile that will result in the release of respirable silica. The plan shall address work procedures and controls to address silica exposure.

#### 1.5.2.3 Occupational and Environmental Assessment Data Report

If initial monitoring is necessary, submit occupational and environmental [sampling results](#) to the Contracting Officer within three working days of collection, signed by the testing laboratory employee performing the analysis, the employee that performed the sampling, and the CP.

In order to reduce the full implementation of [29 CFR 1926.62](#), [29 CFR 1926.1126](#) or [29 CFR 1926.1127](#), the Contractor shall provide documentation. Submit a report that supports the determination to reduce full implementation of the requirements of [29 CFR 1926.62](#), [29 CFR 1926.1126](#) or [29 CFR 1926.1127](#) and supporting the Hazardous Metal and PCB Compliance and Health and Safety Plan.

- a. The initial monitoring shall represent each job classification, or if working conditions are similar to previous jobs by the same employer, provide previously collected exposure data that can be used to estimate worker exposures per [29 CFR 1926.62](#), [29 CFR 1926.1126](#) or [29 CFR 1926.1127](#). The data shall represent the worker's regular daily exposure to lead, cadmium or chromium (VI) for stated work.
- b. Submit worker exposure data gathered during the task based trigger operations of [29 CFR 1926.62](#), [29 CFR 1926.1126](#) or [29 CFR 1926.1127](#) with a complete process description. This includes manual demolition, manual scraping, manual sanding, heat gun, power tool cleaning, rivet busting, cleanup of dry expendable abrasives, abrasive blast enclosure removal, abrasive blasting, welding, cutting and torch burning where lead, cadmium or chromium (VI) containing coatings are present.
- c. The initial assessment shall determine the requirement for further monitoring and the need to fully implement the control and protective requirements including the Hazardous Metal and PCB Compliance and Health and Safety Plan per [29 CFR 1926.62](#), [29 CFR 1926.1126](#) or [29 CFR 1926.1127](#).

#### 1.5.2.4 Medical Examinations

Initial medical surveillance as required by [29 CFR 1926.62](#), [29 CFR 1926.1126](#) or [29 CFR 1926.1127](#) shall be made available to employees exposed to lead, cadmium or chromium (VI) above the action level. Full medical surveillance shall be made available to employees on an annual basis who are or may be exposed to lead, cadmium or chromium (VI) in excess of the action level for more than 30 days a year or as required by [29 CFR 1926.62](#), [29 CFR 1926.1126](#) or [29 CFR 1926.1127](#). Adequate records shall show that employees meet the medical surveillance requirements of [29 CFR 1926.33](#), [29 CFR 1926.62](#), [29 CFR 1926.1126](#) or [29 CFR 1926.1127](#) and [29 CFR 1926.103](#). Provide medical surveillance to all personnel exposed to lead as indicated in [29 CFR 1926.62](#), [29 CFR 1926.1126](#) or [29 CFR 1926.1127](#). Maintain complete and accurate medical records of employees for the duration of employment plus 30 years.

#### 1.5.2.5 Training

Train each employee performing work that disturbs hazardous metals and PCBs, who performs hazardous metal and PCB disposal, and air sampling operations prior to the time of initial job assignment and annually thereafter, in accordance with [29 CFR 1926.21](#), [29 CFR 1926.62](#), [29 CFR 1926.1126](#) or [29 CFR 1926.1127](#) and State and local regulations.

#### 1.5.2.6 Respiratory Protection Program

- a. Provide each employee required to wear a respirator a respirator fit test at the time of initial fitting and at least annually thereafter as required by 29 CFR 1926.62, 29 CFR 1926.1126 or 29 CFR 1926.1127.
- b. Establish and implement a respiratory protection program as required by AIHA Z88.6, 29 CFR 1926.103, 29 CFR 1926.62, and 29 CFR 1926.55, 29 CFR 1926.1126, 29 CFR 1926.1127 and KSC Respiratory Protection Program.

#### 1.5.2.7 Hazard Communication Program

Establish and implement a Hazard Communication Program as required by 29 CFR 1926.59.

#### 1.5.2.8 Hazardous Metal and PCB Waste Management

The Hazardous Metal and PCB Waste Management Plan shall supplement the waste management plans submitted in accordance with Section 01 57 20.00 10, ENVIRONMENTAL PROTECTION PLAN and comply with Federal, State, and local hazardous waste regulations and address:

- a. Identification and classification of wastes associated with the work.
- b. Estimated quantities of wastes to be generated and disposed of.
- c. Names and qualifications of each contractor that will be transporting, storing, treating, and disposing of the wastes. Include the facility location and operator and a 24-hour point of contact.
- d. Names and qualifications (experience and training) of personnel who will be working on-site with hazardous wastes.
- e. List of waste handling equipment to be used in performing the work, to include cleaning, volume reduction, and transport equipment.
- f. Spill prevention, containment, and cleanup contingency measures including a health and safety plan to be implemented in accordance with 29 CFR 1926.65.
- g. Work plan and schedule for waste containment, removal and disposal. Proper containment of the waste includes using acceptable waste containers (e.g., 55-gallon drums) as well as proper marking/labeling of the containers. Wastes shall be cleaned up and containerized daily.
- h. Include processes that may alter or treat waste rendering a hazardous waste non hazardous.

#### 1.5.2.9 Environmental, Safety and Health Compliance

In addition to the detailed requirements of this specification, comply with laws, ordinances, rules, and regulations of Federal, State, and local authorities regarding hazardous metal and PCBs. Comply with the requirements of the current issue of 29 CFR 1926.62, 29 CFR 1926.1126 or 29 CFR 1926.1127. Submit matters regarding interpretation of standards to the Contracting Officer for resolution before starting work. Where specification requirements and the referenced documents vary, the most stringent requirement shall apply. The following KSC requirements regarding



removing, handling, storing, transporting, and disposing of hazardous metal and PCB-contaminated materials apply:

- a. **KNPR 1840.19** KSC Industrial Hygiene Program
- b. **KNPR 8500.1** (2010; Rev B) KSC Environmental Requirements

#### 1.5.3 Pre-Construction Conference

Along with the CP, meet with the Contracting Officer to discuss in detail the Hazardous Metal and PCB Waste Management Plan and the Hazardous Metal and PCB Compliance and Health and Safety Plan, including procedures and precautions for the work.

### 1.6 EQUIPMENT

#### 1.6.1 Respirators

Furnish appropriate respirators approved by the National Institute for Occupational Safety and Health (NIOSH), Department of Health and Human Services, for use in atmospheres containing hazardous metal or PCB dust, fume and mist.

Respirators shall comply with the requirements of **29 CFR 1926.62**, **29 CFR 1926.103**, **29 CFR 1926.1126** and **29 CFR 1926.1127**.

#### 1.6.2 Special Protective Clothing

Furnish personnel who will be exposed to hazardous metal and PCB dust with proper disposable protective whole body clothing, head covering, gloves, eye, and foot coverings as required by **29 CFR 1926.62**, **29 CFR 1926.1126** and **29 CFR 1926.1127**. Furnish proper disposable plastic or rubber gloves to protect hands. Reduce the level of protection only after obtaining approval from the CP.

#### 1.6.3 Rental Equipment Notification

If rental equipment is to be used during hazardous metal and PCB handling and disposal, notify the rental agency in writing concerning the intended use of the equipment.

#### 1.6.4 Vacuum Filters

**UL 586** labeled HEPA filters.

#### 1.6.5 Equipment for Government Personnel

Furnish the Contracting Officer with two complete sets of personal protective equipment (PPE) daily, as required herein, for entry into and inspection of the hazardous metal and PCB removal work within the controlled area. Personal protective equipment shall include disposable whole body covering, including appropriate foot, head, eye, and hand protection. PPE shall remain the property of the Contractor. The Government will provide respiratory protection for the Contracting Officer.

### 1.7 PROJECT/SITE CONDITIONS

#### 1.7.1 Protection of Existing Work to Remain

Perform work without damage or contamination of adjacent areas. Where

existing work is damaged or contaminated, restore work to its original condition or better as determined by the Contracting Officer.

## PART 2 PRODUCTS

Not used.

## PART 3 EXECUTION

### 3.1 PREPARATION

#### 3.1.1 Protection

##### 3.1.1.1 Notification

- a. Notify the Contracting Officer 20 days prior to the start of hazardous metal and PCB work.

- b. The CP shall notify the facility managers of hazardous operations requiring establishment of control areas. Facility managers will forward notifications to facility tenant management points of contact and the MESC IH Office.

The Notification shall include:

- (a) Estimated start date and times.
    - (b) Facility number and name.
    - (c) Work location.
    - (d) Project Identification Number.
    - (e) Contact Name and Phone Number (Construction Management Point of Contact).
    - (f) Brief description of work or operation to be conducted.

##### 3.1.1.2 Control Area

- a. Physical Boundary - Provide physical boundaries around the control area by roping off the area designated in the work plan or providing curtains, portable partitions or other enclosures to ensure that hazardous metal and PCBs will not escape outside of the control area.
    - b. Warning Signs - Provide warning signs at approaches to control areas. Locate signs at such a distance that personnel may read the sign and take precautions before entering the area. Signs shall comply with the requirements of 29 CFR 1926.62, 29 CFR 1926.1126 and 29 CFR 1926.1127.

In addition, signage shall identify the type of work in progress, project identification number and provide the name and phone number of a point of contact for project information and for notification in the event of an emergency.

##### 3.1.1.3 Furnishings

The Government will remove furniture and equipment from the building before hazardous metal and PCB work begins.

##### 3.1.1.4 Heating, Ventilating and Air Conditioning (HVAC) Systems

Shut down, lock out, and isolate HVAC systems that supply, exhaust, or pass through the control areas. Seal intake and exhaust vents in the control area with 6 mil plastic sheet and tape. Seal seams in HVAC components that

pass through the control area.

#### 3.1.1.5 Decontamination Shower Facility

Provide clean and contaminated change rooms and shower facilities in accordance with this specification and 29 CFR 1926.62.

#### 3.1.1.6 Eye Wash Station

Where eyes may be exposed to injurious corrosive materials, suitable facilities for quick drenching or flushing of the eyes shall be provided within the work area.

#### 3.1.1.7 Mechanical Ventilation System

- a. To the extent feasible, use local exhaust ventilation or other collection systems, approved by the CP. Local exhaust ventilation systems shall be evaluated and maintained in accordance with 29 CFR 1926.62.
- b. Vent local exhaust outside the building and away from building ventilation intakes or ensure system is connected to HEPA filters.
- c. Use locally exhausted, power actuated tools or manual hand tools.

#### 3.1.1.8 Personnel Protection

Personnel shall wear and use protective clothing and equipment as specified herein. Eating, smoking, or drinking or application of cosmetics is not permitted in the control area. No one will be permitted in the control area unless they have been appropriately trained and provided with protective equipment.

### 3.2 ERECTION

#### 3.2.1 Control Area Requirements

Establish a control area by completely establishing barriers and physical boundaries around the area or structure where paint and coating removal operations will be performed.

### 3.3 APPLICATION

#### 3.3.1 Hazardous Metal and PCB Work

Perform hazardous metal and PCB work in accordance with approved Hazardous Metal and PCB Compliance and Health and Safety Plan. Use procedures and equipment required to limit occupational exposure and environmental contamination with hazardous metals and PCBs when the work is performed in accordance with 29 CFR 1926.62, 29 CFR 1926.1126 and 29 CFR 1925.1127 and as specified herein. Dispose of paint, coatings or materials coating, hazardous metals and PCBs and associated waste in compliance with Federal, State, and local requirements.

#### 3.3.2 Paint with Hazardous Metals and PCBs or Material Containing Hazardous Metals and PCBs Removal

Manual or power sanding or grinding of hazardous metals and PCBs surfaces or materials is not permitted unless tools are equipped with HEPA

attachments or wet methods. The dry sanding or grinding of surfaces that contain hazardous metals and PCBs is prohibited. Provide methodology for removing hazardous metals and PCBs in the Hazardous Metal and PCB Compliance and Health and Safety Plan. Select hazardous metals and PCBs removal processes to minimize contamination of work areas outside the control area with contaminated dust or other contaminated debris or waste and to ensure that unprotected personnel are not exposed to hazardous concentrations. Describe this removal process in the Hazardous Metal and PCB Compliance and Health and Safety Plan.

Remove paints and coatings 6 inches to either side of areas where torch cutting or abrasive grindings will occur.

#### 3.3.2.1 Paint with Hazardous Metal and PCBs or Material Containing Hazardous Metals and PCBs - Indoor Removal

Perform manual, mechanical removal and thermal cutting in the control areas using enclosures, barriers or containments. Collect residue for disposal in accordance with Federal, State, and local requirements.

#### 3.3.3 Personnel Exiting Procedures

Whenever personnel exit the controlled area, they shall perform the following procedures and shall not leave the work place wearing clothing or equipment worn in the control area:

- a. Vacuum clothing before entering the contaminated change room.
- b. Remove protective clothing in the contaminated change room, and place them in an approved impermeable disposal bag.
- c. Wash hands and face at the site, don appropriate disposable or uncontaminated reusable clothing, move to an appropriate shower facility, shower.
- d. Change to clean clothes prior to leaving the clean clothes storage area.

#### 3.4 FIELD QUALITY CONTROL

##### 3.4.1 Tests

##### 3.4.1.1 Air and Wipe Sampling

Conduct sampling for hazardous metals and PCBs in accordance with 29 CFR 1926.62, 29 CFR 1926.55, 29 CFR 1926.1126 and 29 CFR 1926.1127 and as specified herein. Air and wipe sampling shall be directed or performed by the CP.

- a. The CP shall be on the job site directing the air and wipe sampling and inspecting the paint, coatings or materials containing hazardous metals and PCBs removal work to ensure that the requirements of the contract have been satisfied during the entire operation.
- b. Collect personal air samples every three months on employees who are anticipated to have the greatest risk of exposure as determined by the CP. In addition, collect air samples on at least twenty-five percent of the work crew or a minimum of two employees, whichever is greater, during each work shift.

- c. Submit results of air samples, signed by the CP, within 72 hours after the air samples are taken.
- d. Conduct area air sampling every three months, on each shift in which paint and coating removal operations are performed, in areas immediately adjacent to the control area. Sufficient area monitoring shall be conducted to ensure unprotected personnel are not exposed at or above action levels. If an action level of air is reached or exceeded, stop work, correct the conditions(s) causing the increased levels. Notify the Contracting Officer immediately. Determine if condition(s) require further change in work methods. Removal work shall resume only after the CP and the Contracting Officer give approval.
- e. Surface Wipe Samples - Collect surface wipe samples on floors at a location no greater than 10 feet outside the control area at a frequency of once every three months while removal work is conducted. Surface wipe results shall meet criteria in paragraph "Clearance Certification."

#### 3.4.1.2 Testing of Material Containing Hazardous Metal and PCB Residue

Test residue in accordance with 40 CFR 261 and 40 CFR 761 for hazardous waste and PCBs.

### 3.5 CLEANING AND DISPOSAL

#### 3.5.1 Cleanup

Maintain surfaces of the control area free of accumulations of dust and debris. Restrict the spread of dust and debris; keep waste from being distributed over the work area. Do not dry sweep or use pressurized air to clean up the area. At the end of each shift and when the paint and coating removal operation has been completed, clean the controlled area of visible contamination by vacuuming with a HEPA filtered vacuum cleaner, wet mopping the area and wet wiping the area as indicated by the Hazardous Metal and PCB Compliance and Health and Safety Plan. Reclean areas showing dust or debris. After visible dust and debris are removed, wet wipe and HEPA vacuum surfaces in the controlled area. If adjacent areas become contaminated during the work, clean, visually inspect, and then wipe sample contaminated areas. The CP shall then certify in writing that the area has been cleaned of hazardous metal and PCB contamination before clearance testing.

##### 3.5.1.1 Clearance Certification

The CP shall certify in writing that air samples collected outside the control area during paint removal operations are less than action levels for lead, cadmium and chromium (VI); the respiratory protection used for the employees was adequate; the work procedures were performed in accordance with 29 CFR 1926.62, 29 CFR 1926.1126 and 29 CFR 1926.1127; and that there were no visible accumulations of material and dust containing hazardous metals and PCBs left in the work site. Do not remove the control area or roped off boundary and warning signs prior to the Contracting Officer's acknowledgement of receipt of the CP certification.

Certify surface wipe samples are not significantly greater than the initial surface loading determined prior to work.

Clear the control area in industrial facilities of visible dust and debris.

## 3.5.2 Disposal

Waste streams shall be disposed of in accordance with [KNPR 8500.1](#) KSC Environmental Requirements.

- a. Material, whether hazardous or non-hazardous shall be disposed in accordance with laws and provisions and Federal, State or local regulations. Ensure waste is properly characterized. The Technical Response Package provided by the Contracting Officer and result of each waste characterization (TCLP for RCRA materials) will dictate disposal requirements.
- b. Contractor is responsible for segregation of waste. Collect hazardous metal and PCB contaminated waste, scrap, debris, bags, containers, equipment, and contaminated clothing that may produce airborne concentrations of hazardous metal and PCB particles. Label the containers in accordance with [29 CFR 1926.62](#), [29 CFR 1926.1126](#), [29 CFR 1926.1127](#) and [40 CFR 261](#).
- c. Store waste materials in U.S. Department of Transportation ([49 CFR 178](#)) approved 55 gallon drums. Properly label each drum to identify the type of waste ([49 CFR 172](#)) and the date the drum was filled. For hazardous waste, the collection drum requires marking/labeling in accordance with [40 CFR 262](#) during the accumulation/collection timeframe. The Contracting Officer or an authorized representative will assign an area for interim storage of waste-containing drums. Do not store hazardous waste drums in interim storage longer than 90 calendar days from the date affixed to each drum.
- e. Handle and store, hazardous metal and PCB contaminated waste in accordance with [40 CFR 260](#), [40 CFR 261](#), [40 CFR 262](#), [40 CFR 263](#), [40 CFR 264](#), [40 CFR 265](#), [40 CFR 761](#) and [KNPR 8500.1](#), Rev. B, KSC Requirements.

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## SECTION 05 05 23.00 98

## METAL FASTENINGS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## ASME INTERNATIONAL (ASME)

ASME BPVC SEC IX (2007; Addenda 2008) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

## AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ASNT SNT-TC-1A (2011) Recommended Practice, Personnel Qualification and Certification in Nondestructive Testing

## AMERICAN WELDING SOCIETY (AWS)

AWS A2.4 (2012) Standard Symbols for Welding, Brazing and Nondestructive Examination

AWS A5.1/A5.1M (2004; Errata 2004) Carbon Steel Electrodes for Shielded Metal Arc Welding

AWS A5.17 (1980) Carbon Steel Electrodes and Fluxes for Submerged Arc Welding

AWS D1.1/D1.1M (2010; Errata 2010) Structural Welding Code - Steel

AWS D1.2/D1.2M (2008) Structural Welding Code - Aluminum

AWS D1.6/D1.6M (2007) Structural Welding Code - Stainless Steel

## NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

NASA-SPEC-5004 Welding of Aerospace Ground Support Equipment and Related Nonconventional Facilities

## 1.2 WELD CRITERIA

Except as noted, all carbon steel welding shall be in accordance with AWS D1.1/D1.1M and NASA-SPEC-5004. All aluminum welding shall be in accordance with AWS D1.2/D1.2M and NASA-SPEC-5004. All stainless steel welding shall be in accordance with AWS D1.6/D1.6M and NASA-SPEC-5004 with one exception. The pre-qualified welding procedure specifications



presented in AWS D1.6/D1.6M do not need to be qualified by testing, as stipulated by NASA-SPEC-5004.

Classification: See NASA-SPEC-5004 for classification to establish levels of inspection for structural weldments. All welds require a Class B inspection except where weld is designated as a Class A weld.

### 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

#### SD-01 Preconstruction Submittals

Training data shall be submitted for welding inspectors in accordance with the paragraph entitled, "Certification of Welding Inspectors," of this section; G.

#### SD-02 Shop Drawings

Detail Drawings shall be submitted in accordance with the section entitled, "General" of this section; G.

#### SD-06 Test Reports

Test reports shall be submitted for the following items in accordance with AWS D1.1/D1.1M for carbon steel, AWS D1.2/D1.2M for aluminum, and AWS D1.6/D1.6M for stainless steel. Inspection reports of shop welds shall be submitted within 1 week of test date in accordance with the paragraph entitled "Quality Provisions", of this section.

Welder Qualifications; G  
Inspector Qualification Tests; G  
Inspection reports of shop welds; G

#### SD-07 Certificates

Welding Procedures and Welder Qualifications shall be submitted in accordance with the paragraph entitled, "Qualifications of Welding Procedures and Welders," of this section; G.

Certificates shall be submitted for qualifications of welding procedures and welders in accordance with the paragraph entitled, "Certification of Welding Inspectors," of this section; G.

Certificates for Electrodes; G

#### SD-09 Manufacturer's Field Reports

Inspection Reports of field welds shall be submitted within 1 week of test date in accordance with the paragraph entitled, "Quality Provisions," of this section; G.

### 1.4 QUALIFICATIONS OF WELDING PROCEDURES AND WELDERS

Prior to any production welding, the Contractor shall demonstrate the

satisfactory quality of representative welds by means of tests specified hereinafter under paragraph entitled, "Quality Provisions." Certificates of such qualification shall be current for [welder qualifications](#) and [welding procedures](#) and are subject to the Contracting Officer's approval. Certificates shall have the Government inspector's stamp affixed.

#### 1.5 PROCEDURE AND PERFORMANCE QUALIFICATIONS

Contractor shall qualify welding procedures and welder performances.

Qualifications and certification shall be accomplished in accordance with the applicable portions of [AWS D1.1/D1.1M](#) for carbon steel, [AWS D1.2/D1.2M](#) for aluminum, and [AWS D1.6/D1.6M](#) for stainless steel. Additionally, carbon steel welders and welding operators shall be qualified in accordance with [ASME BPVC SEC IX](#). Copies of certification shall be submitted to the Contracting Officer.

Retesting is not required for renewal of performance qualification if the welder has performed production welding meeting the requirements of this specification within the previous six months.

#### 1.6 CERTIFICATION OF WELDING INSPECTORS

Welding inspectors shall be certified to meet the requirements of [ASNT SNT-TC-1A](#). Contractor may have an in-house level III certified inspector as a designated representative to certify other inspectors at levels I and II. As an option, he may use the services of a private laboratory, approved by the Contracting Officer, to provide a certified level III inspector to conduct qualification training and examination of the Contractor's personnel at level II. In such instances, the responsibility of certification shall be retained by the Contractor. [Inspector Qualification Tests](#) shall meet referenced standards within this and referenced sections.

If a private laboratory is used to provide qualification training and examination of the Contractor's inspectors, the Contractor shall have at least level II nondestructive testing (NDT) inspectors of the applicable testing method on his staff for performance of the required inspections. These inspectors shall be certified to perform inspections of the type required by the specifications.

Contractor may certify a level II inspector in magnetic particle or liquid penetrant and waive the required trainee or level I documented work experience time if the Contractor specifically ascertains that the employee is qualified to properly perform the required inspection and so states in his certification to the Contracting Officer. Once an inspector has been certified, no further training will be required for the life of the contract.

Contractor also has the option of using the services of a private laboratory, approved by the Contracting Officer, to provide the required NDT inspections.

[Training data](#) shall be submitted for welding inspectors. Data shall include description of training, training aids to be used, samples of training materials to be used, and schedules of training.

[Certificates](#) shall be submitted for qualifications of welding procedures and welders including the type of welding and positions each operator is

qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualification tests.

#### 1.7 HANDLING AND STORAGE

All materials used in welding processes shall be stored so that no degradation will result during storage. Handling and storage methods shall be stated in the welding procedure.

### PART 2 PRODUCTS

#### 2.1 GENERAL

Base metal shall be as specified in [AWS D1.1/D1.1M](#) for carbon steel, [AWS D1.2/D1.2M](#) for aluminum, and [AWS D1.6/D1.6M](#) for stainless steel.

Welding rods, welding wire, and electrodes used in welding shall be capable of producing satisfactory welds when used by a certified welding operator with adequate welding apparatus and shall have a composition suitable for producing welds conforming to the requirements of [NASA-SPEC-5004](#).

Fluxes for carbon steel shall be of such composition that the carbon content of the resulting weld metal will be within the limits for the applicable base metal. Fluxes for submerged-arc welding shall be compatible with the filler metal and the base metal and shall be of such a composition that the qualities of the resultant weldment shall be equivalent to or better than those obtained by the electric-arc-coated electrode process.

Anti-spatter compounds, when used, shall be of a consistency and uniformity that degradation of the weldment will not result. Anti-spatter compounds shall also be easy to apply and remove.

[Detail Drawings](#) shall include the following:

Class A welds shall be transposed by the Contractor to detail drawings by designating "A" in the tail of the weld symbol. Detail drawings shall include notes specifying radiographic inspection for Class A welds. These notes shall be detailed enough to ascertain that a satisfactory radiographic inspection can be accomplished considering technique, fabrication sequence, and joint configuration for each Class A weld.

#### 2.2 ELECTRODES FOR MANUAL SHIELDED METAL-ARC WELDING

Electrodes for manual shielded metal-arc welding of carbon steel shall meet the requirements of [AWS D1.1/D1.1M](#). Electrodes shall be, covered mild-steel electrodes, E70 series conforming to [AWS A5.1/A5.1M](#).

#### 2.3 ELECTRODES AND FLUX FOR SUBMERGED-ARC WELDING

The bare electrodes and flux used in combination for submerged-arc welding of carbon steel shall meet the requirements of [AWS D1.1/D1.1M](#) and shall be bare mild-steel electrodes and fluxes F70 series for submerged-arc welding conforming to [AWS A5.17](#).

Shielded metal-arc electrodes having low-hydrogen coverings shall be purchased in hermetically sealed containers or dried for at least 2 hours between [450 and 500 degrees F](#) before they are used. After opening,

hermetically sealed electrodes shall be stored at all times in an oven, supplied by the Contractor, capable of maintaining a temperature of at least 250 degrees F.

The flux used for submerged-arc welding shall be dry and free of contamination from dirt, mill scale, or other foreign material. Flux used in welding shall not be reused.

#### 2.4 FILLER METAL FOR ALUMINUM WELDING

Filler metal shall conform to the requirements of AWS D1.2/D1.2M.

#### 2.5 FILLER METAL FOR STAINLESS STEEL WELDING

Filler metal shall conform to the requirements of AWS D1.6/D1.6M.

### PART 3 EXECUTION

#### 3.1 JOINT PREPARATION

Interpretation of the weld symbols shall be made in accordance with AWS A2.4. Mismatch and misalignment of fit-up shall not exceed the allowable as shown in AWS D1.1/D1.1M for steel, AWS D1.2/D1.2M for aluminum, and AWS D1.6/D1.6M for stainless steel. Root opening of the joint shall be checked before tacking or depositing the first layer to ensure that it is correct. Oxide and protective coatings shall be removed. Surfaces to be welded shall be free of grease and other foreign matter. Any method of removal may be used which does not contaminate the surfaces. Edges to be fusion welded shall be essentially free of defects and finished to a surface roughness in accordance with AWS D1.1/D1.1M for carbon steel, AWS D1.2/D1.2M for aluminum, and AWS D1.6/D1.6M for stainless.

Thermal or mechanical cutting may be used to cut carbon steel. Mechanical cutting may be used to cut stainless steel piping and tubing. Anti-spatter compound, when used, shall be applied to all surfaces adjacent to the joints where it is necessary to control spatter from welding.

#### 3.2 PROTECTION OF EQUIPMENT AND ADJACENT SURFACES

Contractor shall protect equipment and adjacent surfaces during welding operations. Damages resulting from failure to provide protection shall be repaired to the satisfaction of the Contracting Officer, at no additional cost to the Government.

#### 3.3 PROCEDURES

##### 3.3.1 Preheating and Interpass Heating

Temperatures shall be measured by a surface pyrometer or other suitable temperature-indicating means, accurate within plus or minus 25 degrees F. Heating and maintaining the proper temperature shall be accomplished, as applicable, by a furnace, by induction, by a gentle sootfree gas flame, by heat lamps, or by other suitable means capable of providing a reasonably uniform temperature throughout the part. When a gas flame is used for preheating, the area to be welded shall be brushed clean of any soot before tacking or welding.

### 3.3.2 Tacking

Tack welds shall be used as required. Wherever possible, the tack welds shall be spaced symmetrically along or around the joint. Tack welds shall be of sufficient size and length to permit ease of subsequent welding, yet ensure holding of the parts in place without cracking of the tack weld. Chipping or grinding shall be done to fair both ends of the tack welds in with base metal. Tack welds which have cracked shall be removed.

### 3.3.3 Weld Beads

Weld beads shall be terminated so as to avoid critical areas of the weld. Assemblies shall be welded in the flat position whenever practical. The back step and skip methods of welding shall be used to lessen warpage when necessary. Tabs on which the arc can be struck or extinguished may be used wherever practical to minimize porosity at the beginning and end of the weld bead. When manual welding multipass welds in circumferential joints in tubular sections or depositing continuous-circular-butt or fillet-type welds, the first layer, should be deposited by welds in opposite quadrants. All machine welding or circumferential or circular type joints shall be accomplished utilizing a continuous single pass or multiple stringer technique. All groove welded joints which are to be welded from both sides and which require 100 percent penetration shall be back gouged, as necessary, to ensure complete penetration of the joint.

### 3.3.4 Techniques

A maximum of two passes shall be deposited on the first side prior to the back gouging of the back side. The imbalance of passes between sides on double sided weld joints shall not exceed two. Back gouging to sound metal may be done by chisel, grinder, or air carbon-arc process. Gouged areas shall be smoothed to fair in with adjacent metal. Starts and stops of each weld bead shall be chipped or ground as necessary to remove cracks and visible porosity in the weld metal before depositing the subsequent weld bead. Ground areas shall fair in smoothly with the adjacent material. Weld beads shall not terminate in inside corners or in other critical areas such as changes in welding direction or sudden changes in section thickness. Return welds shall be continuously full size around the corner for a length equal to twice the weld size. End returns shall be indicated on design and detail drawings. Corner welds may be a fillet weld, a butt weld, or a combination thereof depending of forming or drawing requirements. Unless otherwise specified, there shall be complete penetration to the inside of the joint permitted for contouring and blending when an inside fillet weld is not specified. The outside of the joint shall blend smoothly with the adjacent metal and unless otherwise specified, sufficient metal shall be added to provide a suitable fillet or reinforcement.

### 3.3.5 Postweld Heat Treatment

Stress relief or heat treatment of welded assemblies is optional unless specifically called for on the drawing.

## 3.4 IN-PROCESS REPAIR OF WELDMENTS

Weld repair shall be performed in accordance with [NASA-SPEC-5004](#). A weld repair is defined as any time defects in weld metal have been corrected.

### 3.5 QUALITY PROVISIONS

#### 3.5.1 Inspection Requirements

Contractor shall perform all inspection requirements as specified. The Contractor shall use his independent inspection facilities and services acceptable to the Government. The provision in NASA-SPEC-5004 that permits use of the Contractor's own inspectors is not applicable for this project. Inspection and test records shall be kept complete and provided to the Contracting Officer or his designated representative. Contracting Officer, or his designated representative, reserves the right to perform (at Government expense and without any increase in contract price) any or all of the inspections set forth in this specification to ensure that the end item conforms to the prescribed requirements. Test records, inspection reports of shop welds, and inspection reports of field welds shall be kept complete and provided to the Contracting Officer or his designated representative within 1 week of the test being performed.

#### 3.5.2 Inspection

Welds shall conform to AWS D1.1/D1.1M for carbon steel, AWS D1.2/D1.2M for aluminum, and AWS D1.6/D1.6M for stainless steel.

Weld inspection shall be performed in accordance with NASA-SPEC-5004A.

Certain Class B welds, whose quality cannot be satisfactorily determined by the testing procedures set forth in "Inspection Requirements" and "Examination of Weldments," as determined by the Contracting Officer, shall be subject to radiographic inspection at Government expense but without increase in contract price.

#### 3.5.3 Examination of Weldments

Joint design tolerance shall be inspected prior to welding to verify compliance with AWS D1.1/D1.1M for steel, AWS D1.2/D1.2M for aluminum, and AWS D1.6/D1.6M for stainless steel. Weld joint fit shall be inspected for accurate alignment to ensure complete and sound penetration of the root pass. Inspector shall also inspect each root pass to ensure complete penetration and soundness.

Visual inspection of all welds shall be accomplished using AWS fillet and butt weld gages.

Magnetic particle inspection of Class B carbon steel weldments shall be performed in accordance with the requirements of AWS D1.1/D1.1M.

Radiographic inspection shall be conducted, when applicable, in accordance with AWS D1.1/D1.1M or AWS D1.6/D1.6M.

#### 3.5.4 Acceptance Criteria

Defects shall not be in excess of those specified in AWS D1.1/D1.1M and NASA-SPEC-5004 for steel, AWS D1.2/D1.2M for aluminum, and AWS D1.6/D1.6M for stainless steel. In case of doubt, the Contracting Officer may require coupons to be cut from base or weld material for destructive tests. When the material of weld does not meet the applicable specifications for strength and soundness, the Contractor shall be liable for the cost of the investigation of the defective area. When coupons are removed from any part of the structure, the members shall be repaired in a neat and

workmanlike manner, with joints of proper type to develop the full strength of the members and joints cut, and with peening as necessary or as directed to relieve residual stress.

#### 3.5.5 Inspection Record

An inspection record for each full penetration weld made in the field shall be prepared. Inspection records shall be made available to the Contracting Officer within 1 week of the test being performed.

#### 3.6 POSTWELD CLEANING

All welded assemblies shall be cleaned free of oxides, flux, scale, weld splatter or other foreign matter prior to final inspection.

-- End of Section --

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## DIVISION 05 - METALS

## SECTION 05 12 00

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## SECTION 05 12 00

## STRUCTURAL STEEL

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS  
(AASHTO)

AASHTO HB-17 (2002; Errata 2003; Errata 2005, 17th  
Edition) Standard Specifications for  
Highway Bridges

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 201 (2006) AISC Certification Program for  
Structural Steel Fabricators

AISC 325 (2005) Steel Construction Manual

AISC 326 (2009) Detailing for Steel Construction

AISC 360 (2005) Specification for Structural Steel  
Buildings

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4 (2012) Standard Symbols for Welding,  
Brazing and Nondestructive Examination

AWS D1.1/D1.1M (2010; Errata 2010) Structural Welding  
Code - Steel

ASME INTERNATIONAL (ASME)

ASME B46.1 (2009) Surface Texture, Surface Roughness,  
Waviness and Lay

ASTM INTERNATIONAL (ASTM)

ASTM A108 (2007) Standard Specification for Steel  
Bar, Carbon and Alloy, Cold-Finished

ASTM A123/A123M (2012) Standard Specification for Zinc  
(Hot-Dip Galvanized) Coatings on Iron and  
Steel Products

ASTM A143/A143M (2007) Standard Practice for Safeguarding  
Against Embrittlement of Hot-Dip  
Galvanized Structural Steel Products and

## Procedure for Detecting Embrittlement

ASTM A153/A153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A193/A193M	(2012) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A276	(2010) Standard Specification for Stainless Steel Bars and Shapes
ASTM A307	(2010) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A325	(2010) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A36/A36M	(2008) Standard Specification for Carbon Structural Steel
ASTM A500/A500M	(2010a) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A529/A529M	(2005; R 2009) Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality
ASTM A53/A53M	(2012) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A563	(2007a) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A572/A572M	(2012) Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A6/A6M	(2012) Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A668/A668M	(2004; R 2009) Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use
ASTM A992/A992M	(2011) Standard Specification for Structural Steel Shapes
ASTM C1107/C1107M	(2011) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

ASTM C827/C827M	(2010) Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures
ASTM F1554	(2007ae1) Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
ASTM F436	(2011) Hardened Steel Washers
ASTM F844	(2007a) Washers, Steel, Plain (Flat), Unhardened for General Use

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1926.756	Steel Erection; Beams and Columns
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## 1.2 SYSTEM DESCRIPTION

Provide the structural steel system, including shop primer or galvanizing, complete and ready for use. Structural steel systems including design, materials, installation, workmanship, fabrication, assembly, erection, inspection, quality control, and testing shall be provided in accordance with AISC 360 and AISC 325 except as modified in this contract.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

### SD-02 Shop Drawings

Erection Plan, including description of temporary supports; G

Fabrication drawings including description of connections; G

### SD-03 Product Data

Shop primer

Welding electrodes and rods

Non-Shrink Grout

### SD-06 Test Reports

Bolts, nuts, and washers

Supply the certified manufacturer's mill reports which clearly show the applicable ASTM mechanical and chemical requirements together with the actual test results for the supplied fasteners.

### SD-07 Certificates

Steel

Bolts, nuts, and washers

Galvanizing

Pins and rollers

AISC Quality Certification

Welding procedures and qualifications

#### 1.4 AISC QUALITY CERTIFICATION

Work shall be fabricated in an AISC certified Category Std fabrication plant.

#### 1.5 QUALITY ASSURANCE

##### 1.5.1 Drawing Requirements

Submit [fabrication drawings](#) for approval prior to fabrication. Prepare in accordance with [AISC 326](#) and [AISC 325](#). Fabrication drawings shall not be reproductions of contract drawings. Sign and seal fabrication drawings by a professional engineer registered in the State of Florida. Include complete information for the fabrication and erection of the structure's components, including the location, type, and size of bolts, welds, member sizes and lengths, connection details, blocks, copes, and cuts. Double connections that require an erection seat to comply with OSHA [29 CFR 1926.756\(c\)\(1\)](#) shall be shown on the shop drawings, reviewed and approved by the structural engineer of record. Use [AWS A2.4](#) standard welding symbols. Shoring and temporary bracing shall be designed and sealed by a Florida registered professional engineer and submitted for record purposes, with calculations, as part of the drawings. Member substitutions of details shown on the contract drawings shall be clearly highlighted on the fabrication drawings. Explain the reasons for any deviations from the contract drawings.

##### 1.5.2 Certifications

###### 1.5.2.1 Erection Plan

Indicate the sequence of erection, temporary shoring and bracing. The Plan shall be developed by a Florida registered professional engineer. The Contractor shall submit and receive written approval of the erection plan from the COTR prior to commencement of field erection.

###### 1.5.2.2 Welding Procedures and Qualifications

See Specification section [05 05 23.00 98](#), METAL FASTENINGS.

Conform to all requirements specified in [AWS D1.1/D1.1M](#).

## PART 2 PRODUCTS

### 2.1 STEEL

#### 2.1.1 Structural Steel

[ASTM A36/A36M](#). [ASTM A529/A529M](#), Grade 50

## 2.1.2 High-Strength Structural Steel

### 2.1.2.1 Low-Alloy Steel

ASTM A572/A572M, Grade 50. ASTM A992/A992M Grade 50.

## 2.1.3 Structural Shapes for Use in Building Framing

Wide flange shapes, ASTM A992/A992M.

## 2.1.4 Structural Steel Tubing

ASTM A500/A500M, Grade B.

## 2.1.5 Steel Pipe

ASTM A53/A53M, Type E or S, Grade B.

## 2.2 BOLTS, NUTS, AND WASHERS

Provide the following unless indicated otherwise.

### 2.2.1 Structural Steel, Steel Pipe

#### 2.2.1.1 Bolts

ASTM A325, Type 1. The bolt heads and the nuts of the supplied fasteners must be marked with the manufacturer's identification mark, the strength grade and type specified by ASTM specifications.

#### 2.2.1.2 Nuts

ASTM A563, Grade and Style for applicable ASTM bolt standard recommended.

#### 2.2.1.3 Washers

ASTM F436 washers for ASTM A325 bolts.

### 2.2.2 High-Strength Structural Steel and Structural Steel Tubing

#### 2.2.2.1 Bolts

ASTM A325, Type 1.

#### 2.2.2.2 Nuts

ASTM A563, Grade and Style as specified in the applicable ASTM bolt standard.

#### 2.2.2.3 Washers

ASTM F436, plain carbon steel.

### 2.2.3 Foundation Anchorage

#### 2.2.3.1 Anchor Bolts

ASTM F1554 Gr 55, Class 1A. Stainless steel ASTM A193/A193M.

#### 2.2.3.2 Anchor Nuts

ASTM A563, Grade A, hex style. Stainless steel ASTM A193/A193M.

#### 2.2.3.3 Anchor Washers

ASTM F844. Stainless steel Type 316 conforming to ASTM A276.

#### 2.2.3.4 Anchor Plate Washers

ASTM A36/A36M Stainless steel Type 316 conforming to ASTM A276.

### 2.3 STRUCTURAL STEEL ACCESSORIES

#### 2.3.1 Welding Electrodes and Rods

AWS D1.1/D1.1M.

#### 2.3.2 Non-Shrink Grout

ASTM C1107/C1107M, with no ASTM C827/C827M shrinkage. Grout shall be nonmetallic.

#### 2.3.3 Welded Shear Stud Connectors

AWS D1.1/D1.1M.

#### 2.3.4 Pins and Rollers

ASTM A668/A668M, Class C, D, F, or G; ASTM A108, Grades 1016 to 1030. Provide as specified in AASHTO HB-17, Division II, Sections 10.26 and 10.27, except provide pins in lengths to extend a minimum of 0.25 inch beyond the outside faces of the connected parts.

#### 2.4 SHOP PRIMER

See Specification section 09 97 13.00 40.

#### 2.5 GALVANIZING

ASTM A123/A123M or ASTM A153/A153M, as applicable, unless specified otherwise galvanize after fabrication where practicable.

#### 2.6 FABRICATION

##### 2.6.1 Markings

Prior to erection, members shall be identified by a painted erection mark. Connecting parts assembled in the shop for reaming holes in field connections shall be match marked with scratch and notch marks. Do not locate erection markings on areas to be welded. Do not locate match markings in areas that will decrease member strength or cause stress concentrations. Affix embossed tags to hot-dipped galvanized members.

## 2.6.2 Shop Primer

### 2.6.2.1 Cleaning and Primer

See Specification section 09 97 13.00 40.

## 2.6.3 Surface Finishes

ASME B46.1 maximum surface roughness of 125 for pin, pinholes, and sliding bearings, unless indicated otherwise.

## 2.7 DRAINAGE HOLES

Adequate drainage holes shall be drilled to eliminate water traps. Hole diameter shall be 1/2 inch and location shall be indicated on the detail drawings. Hole size and location shall not affect the structural integrity.

# PART 3 EXECUTION

## 3.1 FABRICATION

Fabrication shall be in accordance with the applicable provisions of AISC 325. Fabrication and assembly shall be done in the shop to the greatest extent possible. The fabricating plant shall be certified under the AISC 201 for Category STD.

Compression joints depending on contact bearing shall have a surface roughness not in excess of 500 micro inch as determined by ASME B46.1, and ends shall be square within the tolerances for milled ends specified in ASTM A6/A6M.

Structural steelwork, except surfaces of steel to be encased in concrete, surfaces to be field welded, surfaces to be fireproofed, and contact surfaces of friction-type high-strength bolted connections shall be prepared for painting in accordance with endorsement "P" of AISC 201 and primed with the specified paint.

Shop splices of members between field splices will be permitted only where indicated on the Contract Drawings. Splices not indicated require the approval of the Contracting Officer.

## 3.2 INSTALLATION

## 3.3 ERECTION

Erection of structural steel, shall be in accordance with the applicable provisions of AISC 325. Erection plan shall be reviewed, stamped and sealed by a licensed structural engineer.

### 3.3.1 STORAGE

Material shall be stored out of contact with the ground in such manner and location as will minimize deterioration.

## 3.4 CONNECTIONS

Except as modified in this section, connections not detailed shall be designed in accordance with AISC 360. Build connections into existing work. Do not tighten anchor bolts set in concrete with impact torque



wrenches. Punch, subpunch and ream, or drill bolt holes perpendicular to the surface of the member. Holes shall not be cut or enlarged by burning. Bolts, nuts, and washers shall be clean of dirt and rust, and lubricated immediately prior to installation.

#### 3.4.1 Common Grade Bolts

ASTM A307 bolts shall be tightened to a "snug tight" fit. "Snug tight" is the tightness that exists when plies in a joint are in firm contact. If firm contact of joint plies cannot be obtained with a few impacts of an impact wrench, or the full effort of a man using a spud wrench, contact the Contracting Officer for further instructions.

#### 3.4.2 High-Strength Bolts

ASTM A325 bolts shall be fully tensioned to 70 percent of their minimum tensile strength. Bolts shall be installed in connection holes and initially brought to a snug tight fit. After the initial tightening procedure, bolts shall then be fully tensioned, progressing from the most rigid part of a connection to the free edges.

#### 3.5 GAS CUTTING

Use of gas-cutting torch in the field for correcting fabrication errors will not be permitted on any major member in the structural framing. Use of a gas cutting torch will be permitted on minor members not under stress only after approval has been obtained from the Contracting Officer.

#### 3.6 WELDING

See Specification section 05 05 23.00 98.

#### 3.7 GALVANIZING REPAIR

See Specification section 09 97 13.00 40.

#### 3.8 FIELD QUALITY CONTROL

Perform field tests, and provide labor, equipment, and incidentals required for testing, except that electric power for field tests will be furnished as set forth in Division 1. The Contracting Officer shall be notified in writing of defective welds, bolts, nuts, and washers within 7 working days of the date of weld inspection.

##### 3.8.1 Welds

See Specification section 05 05 23.00 98, METAL FASTENINGS.

##### 3.8.2 High-Strength Bolts

###### 3.8.2.1 Testing Bolt, Nut, and Washer Assemblies

Test a minimum of 3 bolt, nut, and washer assemblies from each mill certificate batch in a tension measuring device at the job site prior to the beginning of bolting start-up. Demonstrate that the bolts and nuts, when used together, can develop tension not less than the provisions specified in AISC 360, depending on bolt size and grade. The bolt tension shall be developed by tightening the nut. A representative of the

manufacturer or supplier shall be present to ensure that the fasteners are properly used, and to demonstrate that the fastener assemblies supplied satisfy the specified requirements.

#### 3.8.2.2 Inspection

Inspection procedures shall be in accordance with AISC 360. Confirm and report to the Contracting Officer that the materials meet the project specification and that they are properly stored. Confirm that the faying surfaces have been properly prepared before the connections are assembled. Observe the specified job site testing and calibration, and confirm that the procedure to be used provides the required tension. Monitor the work to ensure the testing procedures are routinely followed on joints that are specified to be fully tensioned.

The Contractor shall inspect bolted connections in accordance with AISC 360.

#### 3.8.2.3 Testing

The Contractor shall have an independent testing agency perform nondestructive tests on 10 percent of the installed bolts to verify compliance with pre-load bolt tension requirements.

The Government has the option to perform nondestructive tests on 5 percent of the installed bolts to verify compliance with pre-load bolt tension requirements. The Contractor shall allow access for the Government to perform the tests. The nondestructive testing will be done in-place using an ultrasonic measuring device or any other device capable of determining in-place pre-load bolt tension. The test locations shall be selected by the Contracting Officer. If more than 10 percent of the bolts tested contain defects identified by testing, then all bolts used from the batch from which the tested bolts were taken, shall be tested at the Contractor's expense. Retest new bolts after installation at the Contractor's expense.

#### 3.8.3 Testing for Embrittlement

ASTM A143/A143M for steel products hot-dip galvanized after fabrication.

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## SECTION 05 50 13

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## SECTION 05 50 13

## MISCELLANEOUS METAL FABRICATIONS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## ALUMINUM ASSOCIATION (AA)

AA DAF45 (2003; Reaffirmed 2009) Designation System for Aluminum Finishes

## AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 303 (2010) Code of Standard Practice for Steel Buildings and Bridges

## AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE A10.3 (2006) Operations - Safety Requirements for Powder Actuated Fastening Systems

## ASME INTERNATIONAL (ASME)

ASME B18.2.1 (2010) Square and Hex Bolts and Screws (Inch Series)

ASME B18.2.2 (2010) Standard for Square and Hex Nuts

ASME B18.21.1 (2009) Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers (Inch Series)

ASME B18.6.2 (1998; R 2010) Slotted Head Cap Screws, Square Head Set Screws, and Slotted Headless Set Screws: Inch Series

ASME B18.6.3 (2010) Machine Screws, Tapping Screws, and Machine Drive Screws (Inch Series)

## ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M (2012) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A153/A153M (2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A283/A283M (2003; R 2007) Standard Specification for

Low and Intermediate Tensile Strength  
Carbon Steel Plates

ASTM A307	(2010) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A325	(2010) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A36/A36M	(2008) Standard Specification for Carbon Structural Steel
ASTM A47/A47M	(1999; R 2009) Standard Specification for Ferritic Malleable Iron Castings
ASTM A500/A500M	(2010a) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A53/A53M	(2012) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A563	(2007a) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A653/A653M	(2011) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A786/A786M	(2005; R 2009) Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates
ASTM A924/A924M	(2010a) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B108/B108M	(2012; E 2012) Standard Specification for Aluminum-Alloy Permanent Mold Castings
ASTM B209	(2010) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B221	(2012) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B26/B26M	(2012) Standard Specification for Aluminum-Alloy Sand Castings
ASTM C1513	(2012) Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections

ASTM D2047

(2011) Static Coefficient of Friction of  
Polish-Coated Floor Surfaces as Measured  
by the James Machine

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM MBG 531

(2009) Metal Bar Grating Manual

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

### SD-02 Shop Drawings

Cover plates and frames, installation drawings; G

Expansion joint covers, installation drawings; G

Floor gratings, installation drawings; G

Embedded angles and plates, installation drawings; G

Submit fabrication drawings showing layout(s), connections to structural system, and anchoring details as specified in AISC 303.

Submit templates, erection and installation drawings indicating thickness, type, grade, class of metal, and dimensions. Show construction details, reinforcement, anchorage, and installation with relation to the building construction.

### SD-03 Product Data

Cover plates and frames

Control-joint covers

Expansion joint covers

Floor gratings

### SD-04 Samples

Expansion joint covers

Control-joint covers

Provide full size samples , taken from manufacturer's stock, and be complete as required for installation in the structure. Samples may be installed in the work, provided each sample is clearly identified and its location recorded.

### 1.3 QUALIFICATION OF WELDERS

See Specification section 05 05 23.00 98.

### 1.4 DELIVERY, STORAGE, AND PROTECTION

Protect from corrosion, deformation, and other types of damage. Store items in an enclosed area free from contact with soil and weather. Remove and replace damaged items with new items.

## PART 2 PRODUCTS

### 2.1 MATERIALS

#### 2.1.1 Structural Carbon Steel

ASTM A36/A36M.

#### 2.1.2 Structural Tubing

ASTM A500/A500M.

#### 2.1.3 Steel Pipe

ASTM A53/A53M, Type E or S, Grade B.

#### 2.1.4 Fittings for Steel Pipe

Standard malleable iron fittings ASTM A47/A47M.

#### 2.1.5 Gratings

a. Metal plank grating, non-slip requirement, aluminum ASTM B209, 6061-T6; steel ASTM A653/A653M, G90.

b. Metal bar type grating NAAMM MBG 531.

#### 2.1.6 Floor Plates, Patterned

Floor plate ASTM A786/A786M. Steel plate shall not be less than 14 gage.

#### 2.1.7 Anchor Bolts

ASTM A325. Where exposed, shall be of the same material, color, and finish as the metal to which applied.

##### 2.1.7.1 Expansion Anchors, Sleeve Anchors and Adhesive Anchors

Provide as indicated on contract drawings.

##### 2.1.7.2 Lag Screws and Bolts

ASME B18.2.1, type and grade best suited for the purpose.

##### 2.1.7.3 Toggle Bolts

ASME B18.2.1.



#### 2.1.7.4 Bolts, Nuts, Studs and Rivets

ASME B18.2.2 or ASTM A307. Nuts that do not conform to ASTM A563 shall be flex-top expanding locknuts.

#### 2.1.7.5 Powder Actuated Fasteners

Follow safety provisions of ASSE/SAFE A10.3.

#### 2.1.7.6 Screws

ASME B18.2.1, ASME B18.6.2, ASME B18.6.3 and ASTM C1513.

#### 2.1.7.7 Washers

Provide plain washers to conform to ASME B18.21.1. Provide beveled washers for American Standard beams and channels, square or rectangular, tapered in thickness, and smooth. Provide lock washers to conform to ASME B18.21.1.

#### 2.1.8 Aluminum Alloy Products

Conform to ASTM B209 for sheet plate, ASTM B221 for extrusions and ASTM B26/B26M or ASTM B108/B108M for castings, as applicable. Provide aluminum extrusions at least 1/8 inch thick and aluminum plate or sheet at least 0.050 inch thick.

### 2.2 FABRICATION FINISHES

#### 2.2.1 Galvanizing

Hot-dip galvanize items specified to be zinc-coated, after fabrication where practicable. Galvanizing: ASTM A123/A123M, ASTM A153/A153M, ASTM A653/A653M or ASTM A924/A924M, G90, as applicable.

#### 2.2.2 Galvanize

Anchor bolts, grating fasteners, washers, and parts or devices necessary for proper installation, unless indicated otherwise.

#### 2.2.3 Repair of Zinc-Coated Surfaces

See Specification section 09 97 13.00 40.

#### 2.2.4 Steel Coatings

See Specification section 09 97 13.00 40.

#### 2.2.5 Nonferrous Metal Surfaces

Protect by plating, anodic, or organic coatings.

#### 2.2.6 Aluminum Surfaces

##### 2.2.6.1 Surface Condition

Before finishes are applied, remove roll marks, scratches, rolled-in scratches, kinks, stains, pits, orange peel, die marks, structural streaks, and other defects which will affect uniform appearance of finished surfaces.

#### 2.2.6.2 Aluminum Finishes

Unexposed sheet, plate and extrusions may have mill finish as fabricated. Sandblast castings' finish, medium, AA DAF45. Unless otherwise specified, provide all other aluminum items with a standard mill finish. Provide a coating thickness not less than that specified for protective and decorative type finishes for items used in interior locations or architectural Class I type finish for items used in exterior locations in AA DAF45. Provide a polished satin finish on items to be anodized.

#### 2.3 CONTROL-JOINT COVERS

Provide control-joint covers to be located on wall surfaces of concrete, masonry and tile work. Provide protective coating on the surface in contact with concrete, masonry or tile.

#### 2.4 COVER PLATES AND FRAMES

Fabricate cover plates of 1/4 inch thick rolled steel weighing not more than 100 pounds per plate with a selected raised pattern nonslip top surface, carbon steel conforming to ASTM A283/A283M having a minimum static coefficient of friction of 0.50 when tested in accordance with ASTM D2047. On wearing surfaces provide aluminum oxide or silicon carbide. Plate shall be galvanized. Frames shall be structural steel shapes and plates, securely fastened to the structure as indicated. Miter and weld all corners. Butt joint straight runs. Allow for expansion on straight runs over 15 feet. Provide flush drop handles for removal formed from 1/4 inch round stock where indicated. Remove sharp edges and burrs from cover plates and exposed edges of frames. Weld all connections and grind top surface smooth. Weld bar stops every six inches. Provide 1/8 inch clearance at edges and between cover plates.

#### 2.5 EXPANSION JOINT COVERS

Provide expansion joint covers constructed of extruded aluminum with anodized satin aluminum finish for walls and ceilings and with standard mill finish for floor covers and exterior covers. Furnish plates, backup angles, expansion filler strip and anchors as indicated. Provide a two-hour fire rating expansion joint system.

#### 2.6 FLOOR GRATINGS

Design steel grating in accordance with NAAMM MBG 531 for bar type grating or manufacturer's charts for plank grating. Galvanize steel floor gratings.

- a. NAAMM MBG 531, band ends of gratings with bars of the same or greater thickness than the metal used for grating. Weld banding bars to the bearing bars or channels at least every fourth bar or channel and in every corner. Tack weld intervening bars or channels. Band diagonal or round cuts by welding bars of the same or greater thickness metal used for grating in accordance with the manufacturer's standard for trim unless otherwise indicated.
- b. Attach gratings to structural members by welding. Connect to structural members according to contract drawings.
- c. Slip resistance requirements must exceed both wet and dry a static coefficient of friction of 0.5.

## 2.7 MISCELLANEOUS PLATES AND SHAPES

Provide for items that do not form a part of the structural steel framework, such as lintels, sill angles, miscellaneous mountings and frames. Provide lintels fabricated from structural steel shapes over openings in masonry walls and partitions as indicated and as required to support wall loads over openings. Provide with connections and welds. Construct to have at least 8 inches bearing on masonry at each end.

Provide angles and plates, ASTM A36/A36M, for embedment as indicated. Galvanize embedded items exposed to the elements according to ASTM A123/A123M.

## PART 3 EXECUTION

### 3.1 GENERAL INSTALLATION REQUIREMENTS

Install items at locations indicated, according to manufacturer's instructions. Verify all measurements and take all field measurements necessary before fabrication. Exposed fastenings shall be compatible materials, shall generally match in color and finish, and harmonize with the material to which fastenings are applied. Include materials and parts necessary to complete each item, even though such work is not definitely shown or specified. Poor matching of holes for fasteners shall be cause for rejection. Conceal fastenings where practicable. Thickness of metal and details of assembly and supports shall provide strength and stiffness. Form joints exposed to the weather shall be formed to exclude water. Items listed below require additional procedures.

### 3.2 WORKMANSHIP

Provide miscellaneous metalwork that is well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching shall produce clean true lines and surfaces. Provide continuous welding along the entire area of contact except where tack welding is permitted. Do not tack weld exposed connections of work in place and ground smooth. Provide a smooth finish on exposed surfaces of work in place and unless otherwise approved, flush exposed riveting. Mill joints where tight fits are required. Corner joints shall be coped or mitered, well formed, and in true alignment. Accurately set work to established lines and elevations and securely fastened in place. Install in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

### 3.3 ANCHORAGE, FASTENINGS, AND CONNECTIONS

Provide anchorage where necessary for fastening miscellaneous metal items securely in place. Include for anchorage not otherwise specified or indicated slotted inserts, expansion shields, and powder-driven fasteners, when approved for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel; through bolts, lag bolts, and screws for wood. Do not use wood plugs in any material. Provide non-ferrous attachments for non-ferrous metal. Make exposed fastenings of compatible materials, generally matching in color and finish, to which fastenings are applied. Conceal fastenings where practicable.

### 3.4 BUILT-IN WORK

Form for anchorage metal work built-in with concrete or masonry, or provide with suitable anchoring devices as indicated or as required. Furnish metal

work in ample time for securing in place as the work progresses.

### 3.5 WELDING

See Specification Section 05 05 23.00 98.

### 3.6 FINISHES

#### 3.6.1 Dissimilar Materials

Where dissimilar metals are in contact, protect surfaces with teflon isolator material to prevent galvanic or corrosive action.

### 3.7 CONTROL-JOINT COVERS

Provide covers over control-joints and fasten on one side only with fasteners spaced to give positive contact with wall surfaces on both sides of joint throughout the entire length of cover.

### 3.8 COVER PLATES AND FRAMES

Install the tops of cover plates and frames flush with floor.

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## DIVISION 05 - METALS

## SECTION 05 51 33

## METAL LADDERS

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## SECTION 05 51 33

## METAL LADDERS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## ALUMINUM ASSOCIATION (AA)

AA DAF45 (2003; Reaffirmed 2009) Designation System for Aluminum Finishes

## AMERICAN WELDING SOCIETY (AWS)

AWS D1.2/D1.2M (2008) Structural Welding Code - Aluminum

## ASTM INTERNATIONAL (ASTM)

ASTM B108/B108M (2012; E 2012) Standard Specification for Aluminum-Alloy Permanent Mold Castings

ASTM B209 (2010) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

ASTM B221 (2012) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

ASTM B26/B26M (2012) Standard Specification for Aluminum-Alloy Sand Castings

## U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.27 Fixed Ladders

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Ladders, installation drawings

## 1.3 QUALIFICATION OF WELDERS

Qualify welders in accordance with AWS D1.2/D1.2M. Use procedures, materials, and equipment of the type required for the work.

#### 1.4 DELIVERY, STORAGE, AND PROTECTION

Protect from corrosion, deformation, and other types of damage. Store items in an enclosed area free from contact with soil and weather. Remove and replace damaged items with new items.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

##### 2.1.1 Aluminum Alloy Products

Conform to [ASTM B209](#) for sheet plate, [ASTM B221](#) for extrusions and [ASTM B26/B26M](#) or [ASTM B108/B108M](#) for castings, as applicable. Provide aluminum extrusions at least [1/8 inch](#) thick and aluminum plate or sheet at least [0.050 inch](#) thick.

#### 2.2 FABRICATION FINISHES

##### 2.2.1 Nonferrous Metal Surfaces

Protect by plating, anodic, or organic coatings.

##### 2.2.2 Aluminum Surfaces

###### 2.2.2.1 Surface Condition

Before finishes are applied, remove roll marks, scratches, rolled-in scratches, kinks, stains, pits, orange peel, die marks, structural streaks, and other defects which will affect uniform appearance of finished surfaces.

###### 2.2.2.2 Aluminum Finishes

Unexposed plate and extrusions may have mill finish as fabricated. Sandblast castings' finish, medium, [AA DAF45](#). Unless otherwise specified, provide all other aluminum items with hand sanded or machine finish to a 240 grit.

#### 2.3 [LADDERS](#)

Fabricate vertical ladders conforming to Section 7 of [29 CFR 1910.27](#). See drawings for details. Rungs to be not less than [24 inches](#) wide, spaced one foot apart, plug welded or shouldered and headed into stringers. Install ladders so that the distance from the rungs to the finished wall surface will not be less than [7 inches](#). Provide heavy clip angles riveted or bolted to the stringer and drilled as indicated. Provide intermediate clip angles not over [48 inches](#) on centers.

##### 2.3.1 Ladder Cages

Conform to [29 CFR 1910.27](#). Fabricate [2 by 1/4 inch](#) horizontal bands and [1 1/2 by 3/16 inch](#) vertical bars. Provide attachments for fastening bands to the side rails of ladders or directly to the structure. Provide and fasten vertical bars on the inside of the horizontal bands. Extend cages horizontally not less than [27 inches](#) or more than [28 inches](#) from the centerline of the rungs, excluding the flare at the bottom of the cage, and not less than [27 inches](#) in width. Clear the inside of the cage of projections. Extend cages vertically above walking surface not less than 42 inches in height.

## PART 3 EXECUTION

### 3.1 GENERAL INSTALLATION REQUIREMENTS

Install items at locations indicated, according to manufacturer's instructions. Verify all measurements and take all field measurements necessary before fabrication. Provide exposed fastenings of compatible materials, generally matching in color and finish, and harmonize with the material to which fastenings are applied. Include materials and parts necessary to complete each item, even though such work is not definitely shown or specified. Poor matching of holes for fasteners will be cause for rejection. Conceal fastenings where practicable. Thickness of metal and details of assembly and supports must provide strength and stiffness. Formed joints exposed to the weather to exclude water. Items listed below require additional procedures.

### 3.2 WORKMANSHIP

Metalwork must be well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching must produce clean true lines and surfaces. Continuously weld along the entire area of contact. Do not tack weld exposed connections of work in place. Grid smooth exposed welds. Provide smooth finish on exposed surfaces of work in place, unless otherwise approved. Where tight fits are required, mill joints. Cope or miter corner joints, well formed, and in true alignment. Install in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

### 3.3 ANCHORAGE, FASTENINGS, AND CONNECTIONS

Provide anchorage where necessary for fastening metal items securely in place. Make exposed fastenings of compatible materials, generally matching in color and finish, to which fastenings are applied. Conceal fastenings where practicable.

### 3.4 WELDING

Perform welding, welding inspection, and corrective welding, in accordance with [AWS D1.2/D1.2M](#). Use continuous welds on all exposed connections. Grind visible welds smooth in the finished installation.

### 3.5 FINISHES

#### 3.5.1 Dissimilar Materials

Where dissimilar metals are in contact, protect surfaces with a teflon isolator material to prevent galvanic or corrosive action.

### 3.6 LADDERS

Secure to the adjacent construction with the clip angles attached to the stringer. Install intermediate clip angles not over [48 inches](#) on center. Install brackets as required for securing of ladders welded or bolted to structural steel.

-- End of Section --



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## DIVISION 05 - METALS

## SECTION 05 52 00

## METAL RAILINGS

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- 1.3 QUALITY ASSURANCE
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## SECTION 05 52 00

## METAL RAILINGS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2010; Errata 2010) Structural Welding  
Code - Steel

## ASME INTERNATIONAL (ASME)

ASME B18.2.1 (2010) Square and Hex Bolts and Screws  
(Inch Series)

ASME B18.21.1 (2009) Washers: Helical Spring-Lock, Tooth  
Lock, and Plain Washers (Inch Series)

## ASTM INTERNATIONAL (ASTM)

ASTM A153/A153M (2009) Standard Specification for Zinc  
Coating (Hot-Dip) on Iron and Steel  
Hardware

ASTM A283/A283M (2003; R 2007) Standard Specification for  
Low and Intermediate Tensile Strength  
Carbon Steel Plates

ASTM A36/A36M (2008) Standard Specification for Carbon  
Structural Steel

ASTM A500/A500M (2010a) Standard Specification for  
Cold-Formed Welded and Seamless Carbon  
Steel Structural Tubing in Rounds and  
Shapes

ASTM A53/A53M (2012) Standard Specification for Pipe,  
Steel, Black and Hot-Dipped, Zinc-Coated,  
Welded and Seamless

ASTM B26/B26M (2012) Standard Specification for  
Aluminum-Alloy Sand Castings

ASTM B429/B429M (2010e1) Standard Specification for  
Aluminum-Alloy Extruded Structural Pipe  
and Tube

## NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 521

(2001) Pipe Railing Manual

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

## SD-02 Shop Drawings

Fabrication Drawings; G

Iron and Steel Hardware; G

Steel Shapes, Plates, Bars and Strips

## SD-03 Product Data

Structural Steel Plates, Shapes, and Bars; G

Structural Steel Tubing; G

Steel Railings; G

Aluminum Railings; G

Anchorage and Fastening Systems; G

## SD-08 Manufacturer's Instructions

Installation Instructions; G

## 1.3 QUALITY ASSURANCE

## 1.3.1 Welding Procedures

Section 05 05 23.00 98 WELDING, STRUCTURAL applies to work specified in this section.

## PART 2 PRODUCTS

## 2.1 SYSTEM DESCRIPTION

Provide complete, detailed fabrication and installation drawings for all iron and steel hardware, and for all steel shapes, plates, bars and strips used in accordance with the design specifications referenced in this section.

Pre-assemble items in the shop to the greatest extent possible. Disassemble units only to the extent necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.

For the fabrication of work exposed to view, use only materials that are smooth and free of surface blemishes, including pitting, seam marks, roller marks, rolled trade names, and roughness. Remove blemishes by grinding, or by welding and grinding, prior to cleaning, treating, and application of

surface finishes, including zinc coatings.

## 2.2 GENERAL FABRICATION

Provide fabrication drawings including railings detail plans and elevations at not less than 1 inch to 1 foot. Provide details of sections and connections at not less than 3 inches to 1 foot. Also detail setting drawings, diagrams, templates for installation of anchorages, including anchor bolts, and miscellaneous metal items having integral anchors.

Use materials of size and thicknesses indicated or, if not indicated, of required size and thickness to produce adequate strength and durability in finished product for intended use. Work materials to dimensions indicated on approved detail drawings, using proven details of fabrication and support. Use type of materials indicated or specified for the various components of work.

Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Ensure all exposed edges are eased to a radius of approximately 1/32 inch. Bend metal corners to the smallest radius possible without causing grain separation or otherwise impairing the work.

Weld corners and seams continuously and in accordance with the recommendations of AWS D1.1/D1.1M. Grind exposed welds smooth and flush to match and blend with adjoining surfaces.

Form exposed connections with hairline joints that are flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of the type indicated or, if not indicated, use Phillips flathead (countersunk) screws or bolts.

Provide anchorage of the type indicated and coordinated with the supporting structure. Fabricate anchoring devices and space as indicated and as required to provide adequate support for the intended use of the work.

Use hot-rolled steel bars for work fabricated from bar stock unless work is indicated or specified to be fabricated from cold-finished or cold-rolled stock.

## 2.3 STRUCTURAL STEEL PLATES, SHAPES AND BARS

Provide structural-size shapes and plates, except plates to be bent or cold-formed, conforming to ASTM A36/A36M, unless otherwise noted.

Provide steel plates, to be bent or cold-formed, conforming to ASTM A283/A283M, Grade C.

Provide steel bars and bar-size shapes conforming to ASTM A36/A36M, unless otherwise noted.

## 2.4 STRUCTURAL STEEL TUBING

Provide structural steel tubing, hot-formed, welded or seamless, conforming to ASTM A500/A500M, Grade B, unless otherwise noted.

## 2.5 STEEL PIPE

Provide pipe conforming to ASTM A53/A53M, type as selected, Grade B; primed finish, unless galvanizing is required; standard weight (Schedule 40).

## 2.6 FASTENERS

Provide galvanized zinc-coated fasteners in accordance with [ASTM A153/A153M](#) suitable for exterior applications. Select fasteners for the type, grade, and class required for the installation of railing items.

Provide square-head lag bolts conforming to [ASME B18.2.1](#).

Provide plain round, general-assembly-grade, carbon steel washers conforming to [ASME B18.21.1](#).

Provide helical spring, carbon steel lockwashers conforming to [ASME B18.2.1](#).

## 2.7 PROTECTIVE COATING

Prepare steelwork as indicated in accordance with Section [09 97 13.00 98](#) STEEL COATINGS.

## 2.8 STEEL RAILINGS

Design guardrails to resist a concentrated load of [200 lbs](#) in any direction at any point of the top of the rail or [20 lbs per foot](#) applied horizontally to top of the rail, whichever is more severe. [NAAMM AMP 521](#), provide the same size rail and post.

### 2.8.1 Steel Guardrails

Provide steel handrails, including steel pipe conforming to [ASTM A53/A53M](#) or structural tubing conforming to [ASTM A500/A500M](#), Grade A or B of equivalent strength. Provide steel railings of [1 1/2 inches](#) nominal size, as shown on the drawings.

- a. Fabrication: Joint posts, rail, and corners by the following method:

- (1) Mitered and welded joints made by fitting post to top rail and intermediate rail to post, mitering corners, groove welding joints, and grinding smooth. Butt railing splices and reinforce them by a tight fitting interior sleeve not less than [6 inches](#) long.

- b. Provide gates as indicated.

Provide toeboard between railing posts where indicated, and consist of [1/8-inch](#) steel flat bars not less than [4 inches](#) high. Secure toeboard as indicated.

## 2.9 ALUMINUM RAILINGS

Provide railings consisting of [1 1/2 inch](#) nominal schedule 40 pipe except where otherwise specified or loading conditions require 1-1/2" nominal schedule 80 pipe, per [ASTM B429/B429M](#). Ensure all fasteners are type 316 stainless steel.

- a. Fabrication: Provide jointing by the following method:

- (1) Assemble railings using slip-on aluminum-magnesium alloy fittings for joints. Fasten fittings to pipe or tube with [1/4 or](#)

3/8 inch stainless steel recessed head setscrews. Provide assembled railings with fittings only at vertical supports or at rail terminations attached to walls. Provide expansion joints at the midpoint of panels. Provide a setscrew in only one side of the slip-on sleeve. Provide alloy fittings to conform to ASTM B26/B26M.

- b. Removable railing sections: Provide removable railing sections as indicated. Provide toeboards and brackets where indicated, using flange castings as appropriate.

## 2.10 GATES

Fabricate gate of rail material indicated. Provide self-closing hinge and cab latch. Basis of design:

Hollaender, Item Number 51216 or 51105

## PART 3 EXECUTION

### 3.1 INSTALLATION INSTRUCTIONS

Submit manufacturer's installation instructions for the following products to be used in the fabrication of hand rail work:

- a. Aluminum railings
- b. Anchorage and fastening systems

Provide complete, detailed fabrication and installation drawings for all iron and steel hardware, and for all steel shapes, plates, bars and strips used in accordance with the design specifications referenced in this section.

### 3.2 PREPARATION

Adjust railings prior to securing in place to ensure proper matching at butting joints and correct alignment throughout their length. Space posts not more than 5 feet on center, unless otherwise indicated on the drawings. Plumb posts in each direction. Secure posts and rail ends as shown on the drawings.

Anchor posts to steel with steel oval flanges, angle type or floor type as required by conditions, welded to posts and bolted to the steel supporting members.

Anchor rail ends to steel with steel oval or round flanges welded to tail ends and bolted to the structural steel members.

Install toeboards and brackets where indicated. Make splices, where required, at expansion joints. Install removable sections as indicated.

### 3.3 STEEL GUARDRAIL

Install steel handrail by welding post to stringers or structural steel frame work with partial penetration welds. Weld toeboard to post.

### 3.4 ALUMINUM GUARDRAIL

Affix to base structure by base plates or flanges bolted to structural

steel framework. Provide type 316 stainless steel bolts to anchor aluminum alloy flanges, of a size appropriate to the standard product of the manufacturer. Where aluminum or alloy fittings or extrusions are to be in contact with dissimilar metals provide isolation as noted on the drawings.

### 3.5 FIELD WELDING

Ensure procedures of manual shielded metal arc welding, appearance and quality of welds made, and methods used in correcting welding work comply with AWS D1.1/D1.1M.

### 3.6 TOUCHUP PAINTING

Immediately after installation, clean field welds, bolted connections, abraded areas and touch up finish in accordance with Section 09 97 13.00 98 STEEL COATINGS as required.

-- End of Section --

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## DIVISION 09 - FINISHES

## SECTION 09 90 00.00 98

## PAINTING AND COATING

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## SECTION 09 90 00.00 98

## PAINTING AND COATING

## PART 1 GENERAL

This specification section includes painting requirements for architectural surfaces such as aluminum guardrails. For additional coating requirements refer to Section 09 97 13.00 98 STEEL COATINGS

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## ASTM INTERNATIONAL (ASTM)

ASTM C 920 (2011) Standard Specification for  
Elastomeric Joint Sealants

## THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 1 (1982; E 2004) Solvent Cleaning

## U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD-595 (Rev C) Colors Used in Government  
Procurement

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

## SD-01 Preconstruction Submittals

Material Safety Data Sheets shall be submitted to the Contracting Officer.; G

Manufacturer's Standard Color Charts shall be submitted for architectural painting materials in accordance with the paragraph entitled, "General," of this section.; G

A Safety Plan; G shall be submitted to the Contracting Officer.

## SD-03 Product Data

Manufacturer's catalog data shall be submitted for the following items including designated name, formula or specification number, manufacturer's instructions and name of manufacturer. Data shall include detailed analysis of each coating material required, with constituents measured as percentages of the total weight of coating; and details of application, thinning, and average

coverage per gallon.

Abrasive Blasting Material; G  
Sealant Compound; G  
Inhibitive Polyamide Epoxy; G  
Aliphatic Polyurethane; G

Material, Equipment, and Fixture Lists  
Mix Designs; G

#### SD-08 Manufacturer's Instructions

Manufacturer's Instructions; G shall be submitted for architectural coatings in accordance with paragraph entitled, "General," of this section.

### 1.3 DELIVERY, HANDLING AND STORAGE

Materials shall be delivered in their original, unbroken containers bearing the manufacturer's name and product identification.

All paint materials, thinners, and cleaners shall be stored in tightly closed containers in a covered, well-ventilated area where they will not be exposed to excessive heat, sparks, flame, or direct sunlight. Water-based materials shall be protected against freezing.

Material Safety Data Sheets shall be submitted by the contracting officer.

### 1.4 GENERAL

A Safety Plan shall be submitted for protective coating systems in accordance with OSHA regulations. See paragraph 3.1.1 for requirements.

Material, Equipment, and Fixture Lists shall be submitted for manufacturer's style or catalog numbers, specification and drawing reference numbers and warranty information for the Protective Coatings Systems fabrication site.

Manufacturer's Standard Color Charts shall be submitted showing manufacturer's standard finish colors. Three color chips of each color shall also be submitted.

Mix Designs shall be submitted for each type of protective coating including a complete list of ingredients and admixtures. Applicable test report shall verify that the mix has been successfully tested and meets design requirements.

### 1.5 CONTRACTOR PERSONNEL QUALIFICATION

Personnel assigned to the work shall be certified by the Contractor to have had adequate previous experience in the successful application of paints and coatings similar to those specified.

### 1.6 WARRANTY

Contractor shall guarantee all work against defects in labor and material for a period of one year.

## PART 2 PRODUCTS

## 2.1 GENERAL

The following are suggested paint manufacturers and their products that have been tested and approved by the government. Substitute paints are not acceptable. All thinners and cleaners shall be products of the coating manufacturer. Primer and finish coats of the paint system shall be products of the same manufacturer.

[Manufacturer's Instructions](#) shall be submitted for architectural coatings showing printed instructions covering thinning, mixing, handling, and applying.

## 2.2 ABRASIVE BLASTING MATERIAL

[Abrasive Blasting Material](#) for aluminum surfaces shall be walnut shells, plastic media or approved equivalent.

## 2.3 SEALANT COMPOUND

[Sealant Compound](#) shall be a self-curing, single component, polysulfide-rubber type conforming to [ASTM C 920](#) Type S, Grade NS, Class 25, use NT, A and O. Sealant shall be gray in color and capable of being applied into the joint with a caulking gun.

## 2.4 EPOXY

An [Inhibitive Polyamide Epoxy](#) shall be selected from the following listing.

All coatings thinners, and cleaners shall be the product of the same manufacturer.

Section I. Materials with Greater than 420 Grams/Liter (3.5 Pounds/Gallon) VOC (SB is Solvent-Based and WB is Water-Based):

<u>Epoxy</u>	<u>Manufacturer</u>
Devran 201 (SB)	International Paint LLC/Devoe Coatings 6001 Antoine Drive Houston, TX 77091 (713) 682-1711 (800) 654-2616 <a href="http://www.international-pc.com">www.international-pc.com</a>
PittGuard 95-245 (SB)	PPG Industries, Inc. One PPG Place Pittsburgh, PA 15272 (800) 722-4509 <a href="http://www.ppg.com">www.ppg.com</a>

Section II. Materials with Less than 340 Grams/Liter (2.8 Pounds/Gallon) VOC (SB is Solvent-Based and WB is Water-Based):

<u>Epoxy</u>	<u>Manufacturer</u>
Amerlock 400 (SB)	PPG Industries, Inc.

Epoxy

Amerlock 2/400 (SB)\*

Manufacturer

One PPG Place  
Pittsburgh, PA 15272  
(800) 722-4509  
[www.ppgamercoatus.ppgpmc.com](http://www.ppgamercoatus.ppgpmc.com)

Carboguard 893 (SB)  
Carbomastic 15 (SB)

Carboline Company  
2150 Schuetz Road  
St. Louis, MO 63146  
(314) 644-1000  
[www.carboline.com](http://www.carboline.com)

Devran201H (SB)

International Paint LLC/Devoe Coatings  
6001 Antoine Drive  
Houston, TX 77091  
(713) 682-1711 (800) 654-2616  
[www.international-pc.com](http://www.international-pc.com)

Macropoxy 646-100

Sherwin-Williams  
101 Prospect Avenuet  
Cleveland, OH 44115  
(800) 336-1110  
[www.sherwin-williams.com](http://www.sherwin-williams.com)

Interseal 670HS (SB)

International Paint LLC  
6001 Antoine Drive  
Houston, TX 77091  
(713) 682-1711 (800) 654-2616  
[www.international-pc.com](http://www.international-pc.com)

## 2.5 POLYURETHANE

An Aliphatic Polyurethane finish coat shall be selected from the following listing and all coatings, thinners, and cleaners shall be the product of the same manufacturer. Each successive coating shall be of a contrasting color to provide a visual assurance of complete coverage.

Section I. Materials with Greater than 420 Grams/Liter (3.5 Pounds/Gallon) VOC (SB is Solvent-Based and WB is Water-Based):

<u>Topcoat (Type)</u>	<u>Manufacturer</u>
Devthane 359 (SB) Devthane 369 (SB) Devthanw 379 UVA (SB)	International Paint LLC/Devoe Coatings 6001 Antoine Drive Houston, TX 77091 (713) 682-1711 (800) 654-2616 <a href="http://www.international-pc.com">www.international-pc.com</a>
Pittthane 95-812 (SB)	PPG Industries, Inc. One PPG Place Pittsburgh, PA 15272 (800) 722-4509 <a href="http://www.ppg.com">www.ppg.com</a>

Section II. Materials with Less than 340 Grams/Liter (2.8 Pounds/Gallon)  
VOC (SB is Solvent-Based and WB is Water-Based):

<u>Topcoat (Type)</u>	<u>Manufacturer</u>
Amercoat 450HS (SB) PSX1001 (SB) Americoat 450H (SB) Amercoat 335 (SB)	PPG Industries, Inc. One PPG Place Pittsburgh, PA 15272 (800) 722-4509 <a href="http://www.ppg.com">www.ppg.com</a>
Carbothane 134HS (SB) Carboacrylic 3359 (WB) Carboxane 2000 (SB)	Carboline Company 2150 Schuetz Road St. Louis, MO 63146 (314) 664-1000 <a href="http://www.carboline.com">www.carboline.com</a>
Devthane 379 (SB)	International Paint LLC/Devoe Coatings 6001 Antoine Drive Houston, TX 77091 (713) 682-1711 (800) 654-2616 <a href="http://www.international-pc.com">www.international-pc.com</a>
Hydrogloss WB (WB) Hi-Solids Poly-CA (SB)	Sherwin-Williams 101 Prospect Avenue Cleveland, OH 44115 (800) 336-1110
Interfine 979 (SB) Interfine 878 (SB)	International Paint LLC 6001 Antoine Drive Houston, TX 77091 (713) 682-1711 <a href="http://www.international-pc.com">www.international-pc.com</a>

## 2.6 APPROVED SYSTEMS

All coatings, thinners, and cleaners shall be the product of the same manufacturer. Each successive coating shall be of a contrasting color to provide a visual assurance of complete coverage.

<u>Primer (Type)</u>	<u>Base Coat (Type)</u>	<u>Topcoat (Type)</u>	<u>Manufacturer</u>
N/A	Devran 201 (SB)	Devthane 359 (SB)	ICI Devoe Coatings 4000 Dupont Circle Louisville, KY 40207 (800) 654-2616 <a href="http://www.devoecoatings.com">www.devoecoatings.com</a>
N/A	Devran 201 (SB)	Devthane 369 (SB)	
N/A	Devran 201 (SB)	Devthane 379UVA (SB)	
N/A	PittGuard 95-245 (SB)	PittThane 95-812 (SB)	PPG Industries, Inc. One PPG Place Pittsburgh, PA 15272 (800) 722-4509 <a href="http://www.ppg.com">www.ppg.com</a>
N/A	Amerlock 400 (SB)	Amercoat 450 (SB)	PPG Industries, Inc. One PPG Place Pittsburgh, PA 15272 (800) 722-4509 <a href="http://www.ppgamercoatus.ppgpmc.com">www.ppgamercoatus.ppgpmc.com</a>
N/A	Amerlock 2/400 (SB)	Amercoat 450H (SB)	
N/A	Amerlock 2/400 (SB)	Amercoat 335 (SB)	
N/A	Carboguard 893 (SB)	Carbothane 134HS (SB)	Carboline Co. 2150 Schuetz Road St. Louis, MO 63146 (314) 644-1000 <a href="http://www.carboline.com">www.carboline.com</a>
N/A	Carbomastic 15 (SB)	Carboacrylic 3359 (WB)	
N/A	Carboguard 893 (SB)	Carboacrylic 3359 (WB)	
N/A	Devran 201H (SB)	Devthane 379 (SB)	ICI Devoe Coatings 4000 Dupont Circle Louisville, KY 40207 (800) 654-2616 <a href="http://www.devoecoatings.com">www.devoecoatings.com</a>
N/A	Macropoxy 646-100 (SB)	Hydrogloss WB (WB)	Sherwin-Williams 101 Prospect Ave. Cleveland, OH 44115 (800) 336-1110 <a href="http://www.sherwin-williams.com">www.sherwin-williams.com</a>
N/A	Macropoxy 646-100 (SB)	Hi-Solids Poly-CA (SB)	
N/A	Interseal 670HS (SB)	Interfine 979 (SB)	International Paint 6001 Antoine Drive Houston, TX 77091 (713) 682-1711 <a href="http://www.international-pc.com">www.international-pc.com</a>
N/A	Interseal 670HS (SB)	Interfine 878 (SB)	

## PART 3 EXECUTION

## 3.1 GENERAL

Manufacturer's recommendations for surface preparation, thinning, mixing, handling, and applying his product shall be considered a part of this specification. In case of conflict between the manufacturer's

recommendations and the requirements of this specification, the latter shall take precedence.

### 3.2 PROTECTION

Contractor shall remove and reinstall, or provide acceptable protection for, all hardware, accessories, lighting and electrical components, factory-finished materials, plumbing fixtures and fittings, and any other materials that may become splattered or damaged by the painting work. "WET PAINT" signs shall be posted to indicate newly painted surfaces.

Every precaution shall be taken to prevent damage to adjacent surfaces. Roping, barricading or covering to preclude damage to personal and real property during surface preparation and painting shall be the Contractor's responsibility. When spray painting, the Contractor must give 24 hours advance warning, coordinated with the Contracting Officer or his representative, and post signs to ensure appropriate warning.

### 3.3 SURFACE PREPARATION

#### 3.3.1 General Surface Preparation

All surfaces shall be clean, dry, and free from contaminants and foreign matter. All chipped, peeling, or blistered paint shall be removed and the surface spot-primed. Hard, glossy surfaces shall be dulled and roughened to ensure proper adhesion.

All aluminum surfaces shall be brush blasted and coated per paragraph 3.7.1 of this specification.

##### 3.3.1.1 Coating Instructions

Manufacturer's recommendation for thinning, mixing, handling and applying his product shall be considered a part of this specification. In the event of conflict between the requirements of this specification and the manufacturer's recommendations, this specification shall take precedence.

Compressed air used for spraying coatings shall be free of moisture and oil.

Each coat of material applied shall be free from runs, sags, blisters, and bubbles; variations in color, gloss, and texture; holidays (missed areas); excessive film build; foreign contaminants; dry overspray. Masking shall be complete and each coat applied shall form a film of uniform thickness.

All coatings shall be thoroughly worked into all joints, crevices and open spaces.

All coatings shall be applied by airless or conventional spray.

##### 3.3.1.2 Weather Conditions

No coatings shall be applied when contamination from rainfall is imminent or when the temperature or humidity is outside limits recommended by the coating manufacturer. To prevent moisture condensation during application, surface temperature must be at least 3 degrees Celsius (5 degrees Fahrenheit) above the dewpoint. Wind speed shall not exceed 25 kilometers per hour (15 miles per hour) in the immediate coating area when using spray application methods.

### 3.3.2 Masonry Surfaces

All surfaces shall be free from form-release compounds, laitance, and other contaminants.

Large cracks, voids and other major surface imperfections shall be repaired before painting. All repairs to cracks and openings in cement block or masonry surfaces shall require preparation of a "V" type opening with the top of the "V" one-half the depth of the crack or opening. All non-tenacious material shall be removed, then the "V" shall be filled using Portland cement grout.

### 3.3.3 Sealing

All cracks, crevices, and joints such as those along the perimeter of doors and mounted fixtures shall be sealed with a paintable polysulfide type caulking.

Sealant shall be a self-curing, single component, polysulfide-rubber type conforming to [ASTM C 920](#) Type S, Grade NS, Class 25, use NT, A and O. Sealant shall be gray in color and capable of being applied into the joint with a caulking gun.

## 3.4 MIXING AND APPLICATION

### 3.4.1 General

All painting shall be accomplished in accordance with the painting schedule.

No paints or coatings shall be applied when the temperature or humidity is outside the limits recommended by the manufacturer, per 3.3.1.2.

Paints and coatings shall be applied by brush, roller, or airless spray.

Each coat of material applied shall be free from runs, sags, bubbles, and foreign contaminants; variations in color, gloss and texture; dry overspray, brush, and roller marks; holidays (missed areas); or other evidence of poor application.

All paints and coatings shall be thoroughly worked into corners and crevices.

Paints and coatings shall be neatly "cut-in" around doors, windows, ceilings, etc.

All newly painted surfaces shall be adequately protected from damage.

### 3.4.2 Procedures

Coatings shall be applied as follows:

- a. Material shall be thoroughly stirred to produce a uniform mixture.
- b. Material shall be thinned for workability and improved spray characteristics, but only according to the manufacturer's instructions.
- c. Each coat shall be applied uniformly at the minimum wet-film thickness specified by the manufacturer.



- d. Special attention shall be given when coating sharp edges, corners, and crevices to ensure complete coverage.
- e. Finish coats shall show good hiding characteristics and uniform appearance.

### 3.5 SPOT-PAINTING

Spot-painting to correct damaged surfaces will be allowed only when touchup area blends into the surrounding finish. Otherwise, the entire area shall be recoated. Touchup shall be accomplished using the same method of application as was used to apply the original material.

### 3.6 ACCEPTANCE PROVISIONS

#### 3.6.1 Inspection

Work as described herein shall be inspected for compliance with this specification by an independent NACE (National Association of Corrosion Engineers) Certified Coating Inspector Level 3 provided by the Contractor. See Section 09 97 13.0098, paragraph 3.5

#### 3.6.2 Cleanup

Contractor shall be responsible for removal of all paint or coating splatter and spills from floors, adjacent walls, hardware, and all other finished surfaces.

Contractor shall leave the work area clean and free from all rubbish and accumulated material left from his work.

### 3.7 PAINT SCHEDULE

#### 3.7.1 Exterior Paint Schedule

Colors shall be in accordance with FED-STD-595.

<u>SURFACE DESCRIPTION</u>	<u>SURFACE PREPARATION</u>	<u>COATING</u>	<u>FINISH COLOR</u>	<u>DRY-FILM THICKNESS</u>
Aluminum removable	SP-10**	Epoxy		Per Mfg's instructions
Guardrails		Urethane	Orange 12473*	Per Mfg's instructions

\* FED-STD-595 Color Identification Number

\*\* Abrasive blasting of aluminum guardrails followed by solvent wipe (SSPC SP 1) is the preferred method for preparing the aluminum surfaces, provided that adequate procedures are implemented to prevent distortion or damage to the aluminum components.

-- End of Section --

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## SECTION 09 97 13.00 98

## STEEL COATINGS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## ASTM INTERNATIONAL (ASTM)

ASTM A 123 (2002) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM C 920 (2011) Standard Specification for Elastomeric Joint Sealants

## U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD 595 (Rev C; 2008) Colors Used in Government Procurement

## U.S. Department of Defense (DOD)

MIL-A-22262 (1959) Abrasive Blast Ship Hull Blast Cleaning

MIL-PRF-24667 (1987) Coating System Non-Skid Roll or Spray

## NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

KSC-STD-SF-0004 (Rev B) Safety Standard for Ground Piping Systems Color Coding and Identification

## THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC AB-1 (2000) Mineral and Slag Abrasives

SSPC SP 1 (1982; E 2004) Solvent Cleaning

SSPC SP 7 (2007) Brush-Off Blast Cleaning

SSPC SP 10 (2007) Near-White Blast Cleaning

SSPC SP 11 (1987; E 2004) Power Tool Cleaning to Bare Metal

SSPC SP 3 (2004; E 2004) Power Tool Cleaning

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

### SD-01 Preconstruction Submittals

**Material Safety Data Sheets; G** shall be submitted in accordance with the paragraph entitled, "delivery, handling and storage", of this section.

**Material, Equipment, and Fixture Lists; G** shall be submitted in accordance with the paragraph entitled, "General," of this section.

**Manufacturer's Color Samples; G** shall be submitted for painting materials in accordance with the paragraph entitled, "General", of this section.

A **Safety Plan; G** shall be submitted in accordance with paragraph entitled, "General," of this section.

**Mix Designs; G** shall be submitted in accordance with paragraph entitled, "General", of this section.

**Coating Inspector Plan; G** shall be submitted in accordance with paragraph entitled, "Inspection" of this section.

Waste Management **Plan; G** shall be submitted in accordance with Section 01 57 20.00 10 ENVIRONMENTAL PROTECTION.

### SD-02 Shop Drawings

**Coating Repair Plan; G** shall be submitted for each piece of GFE in accordance with the paragraph entitled, "Touch-up" of this section.

### SD-03 Product Data

Manufacturer's catalog data; shall be submitted for the following items, including designated name, formula or specification numbers, manufacturer's instructions and name of manufacturer. Data shall include detailed analysis of each coating material required, with constituents measured as percentages of the total weight of coating; and details of application, thinning, and average coverage per liter gallon:

**Abrasive Blasting Material; G**  
**Sealant Compound; G**  
**Inorganic Zinc; G**  
**Aliphatic Polyurethane; G**  
**Non-skid coating; G**

### SD-06 Test Reports

**Inspection reports; G** shall be submitted for protective coating systems in accordance with paragraph entitled, "Inspection," of this section.

**Daily Inspection Reports; G** shall be submitted for protective

coating systems in accordance with paragraph entitled, "Inspection," of this section.

#### SD-08 Manufacturer's Instructions

Manufacturer's instructions shall be submitted for [Protective Coatings](#); [G](#) including details of thinning, mixing, handling, and application.

### 1.3 SCOPE

This section covers materials, surface preparation and the application of protective coatings on all new structure and equipment installed under this contract as well as any existing coating damaged by construction activities. This specification does not apply to existing equipment, systems and structure, except as indicated.

### 1.4 DELIVERY, HANDLING AND STORAGE

Materials shall be delivered in their original, unbroken containers bearing the manufacturer's name, product identification, and batch number. Coatings, thinners, and cleaners shall be stored in tightly closed containers in a covered, well-ventilated area where they will be protected from exposure to extreme cold or heat, sparks, flame, direct sunlight, or rainfall. Manufacturer's instructions for storage limitations shall be followed.

[Material Safety Data Sheets](#) shall be submitted by the Contractor.

### 1.5 PROTECTION OF EQUIPMENT AND ADJACENT SURFACES

All equipment and adjacent surfaces that may be damaged as a result of any phase of this work shall be protected.

### 1.6 GENERAL

A [Safety Plan](#) shall be submitted for protective coating systems in accordance with OSHA regulations. See paragraph 3.1.1 for requirements.

[Material, Equipment, and Fixture Lists](#) shall be submitted for manufacturer's style or catalog numbers, specification and drawing reference numbers and warranty information for the Protective Coatings Systems fabrication site.

[Manufacturer's Color Samples](#) shall be submitted showing the manufacturer's match of the FED standard finish colors specified.

[Mix Designs](#) shall be submitted for each type of protective coating including a complete list of ingredients and admixtures. Applicable test report shall verify that the mix has been successfully tested and meets design requirements.

## PART 2 PRODUCTS

### 2.1 ABRASIVE BLASTING MATERIAL

Blasting aggregates for use on carbon steel shall be approved materials in accordance with [MIL-A-22262](#) or [SSPC AB-1](#), Type I or II, Class A, or steel grit. Only materials approved in the QPL attached to [MIL-A-22262](#) shall be

used. The abrasive grade selected must produce the required surfaces profile and possess physical properties that are compatible with the requirements of this standard. The steel grit shall be neutral (6.0 to 8.0 pH), rust and oil free, dry, commercial-grade blasting grit with a hardness to 40 to 50 Rockwell C. The size shall be selected to produce the required anchor profile. All abrasive blasting material shall be silica free.

Steel grit shall not be used as the blasting aggregate for stainless steel. Abrasive blasting material for stainless steel surfaces shall be walnut shells, plastic media, or approved equivalent.

## 2.2 SEALANT COMPOUND

Sealant shall be a self-curing, single component, polysulfide-rubber type conforming to **ASTM C 920** Type S, Grade NS, Class 25, use NT, A and O. Sealant shall be gray in color and capable of being applied into the joint with a calking gun.

## 2.3 PROTECTIVE COATINGS

### 2.3.1 Coating Systems

All carbon steel surfaces shall be abrasive blasted per **SSPC SP 10** and coated with inorganic zinc unless otherwise noted specifically on the drawings or paragraph 3.7 Coating Schedule of this specification.

All stainless steel surfaces shall be degreased and brush blasted per **SSPC SP 7** and coated with coating system No. 6 unless specifically noted in the drawings or paragraph 3.7 COATING SCHEDULE of this specification.

Special care must be taken to avoid damaging surfaces when blasting, especially thin-walled items.

The following are suggested paint manufacturers and their products which have been tested and approved by the government. Substitute paints are not acceptable. All thinners and cleaners shall be products of the coating manufacturer. Primer and finish coats of the paint system shall be products of the same manufacturer.

All products have been approved for use by NASA. However, not all products are appropriate for all weather/environmental conditions. It is the responsibility of the Contractor to select the products for use on the project.

The following coating systems definitions are to be specified for use on the surfaces listed in the Coating Schedules, of this section, and as directed.

#### COATING SYSTEM NO. 1

Coating System No. 1 shall consist of **inorganic zinc** only. Inorganic zinc shall be selected from the following listing. Coatings, thinners, and cleaners shall be the product of one manufacturer.

Section I. Materials with Greater than 400 Grams/Liter (3.3 Pounds/Gallon) VOC (SB is Solvent-Based and WB is Water-Based):

<u>Coating Designation</u>	<u>Type</u>	<u>Manufacturer</u>
Dimetcote 9	SB	PPG Industries, Inc. One PPG Place Pittsburgh, PA 15272 (800) 722-4509 <a href="http://www.ppgamercoatus.ppgpmc.com">www.ppgamercoatus.ppgpmc.com</a>
Carbo-Zinc 11	SB	Carboline Company 2150 Schuetz Road St. Louis, MO 63146 (314) 644-1000 <a href="http://www.carboline.com">www.carboline.com</a>
Cathacoat 304L	SB	ICI Devoe Coatings 4000 Dupont Circle Louisville, KY 40207 (800) 654-2616 <a href="http://www.devoecoatings.com">www.devoecoatings.com</a>
Cathacoat 304K	SB	
Metalhide 1001	SB	PPG Industries, Inc. One PPG Place Pittsburgh, PA 15272 (800) 722-4509 <a href="http://www.ppg.com">www.ppg.com</a>
Zinc-Clad II	SB	Sherwin-Williams Company 101 Prospect Avenue N.W. Cleveland, OH 44115 (800) 336-1110 <a href="http://www.sherwin-williams.com">www.sherwin-williams.com</a>

Section II. Materials with Less than 400 Grams/Liter (3.3 Pounds/Gallon)  
VOC (SB is Solvent-Based and WB is Water-Based):

<u>Coating Designation</u>	<u>Type</u>	<u>Manufacturer</u>
Dimetcote D-9H	SB	PPG Industries, Inc. One PPG Place Pittsburgh, PA 15272 (800) 722-4509 <a href="http://www.ppgamercoatus.ppgpmc.com">www.ppgamercoatus.ppgpmc.com</a>
Dimetcote D-9HS	SB	
Carbo-Zinc 11HS	SB	Carboline Company 2150 Schuetz Road St. Louis, MO 63146 (314) 644-1000 <a href="http://www.carboline.com">www.carboline.com</a>
Carbo-Zinc 11 VOC	SB	
Carbo-Zinc 11 WB	WB	
Cathacoat 305	WB	ICI Devoe Coatings 4000 Dupont Circle Louisville, KY 40207 (800) 654-2616 <a href="http://www.devoecoatings.com">www.devoecoatings.com</a>
Cathacoat 304V	SB	
InterZinc 22HS	SB	International Paint 6001 Antoine Drive Houston, TX 77091

<u>Coating Designation</u>	<u>Type</u>	<u>Manufacturer</u> (713) 682-1711 <a href="http://www.international-pc.com">www.international-pc.com</a>
Zinc-Clad XI	WB	Sherwin-Williams Company 101 Prospect Avenue N.W. Cleveland, OH 44115 (800) 336-1110 <a href="http://www.sherwin-williams.com">www.sherwin-williams.com</a>
Zinc-Clad II Plus	SB	
Kolor-Zinc 2.8 VOC	SB	Keeler & Long/PPG 856 Echo Lake Road Watertown, CT 06795 (800) 238-8596 <a href="http://www.ppg.com/coatings/pmc/brands/keelerlong">www.ppg.com/coatings/pmc/brands/keelerlong</a>

## COATING SYSTEM NO. 2

Coating System No. 2 applies to hot dipped galvanized items. Rigid steel conduit shall be coated with coating System No.2.

Galvanized surfaces to be top coated shall be prepared by solvent cleaning per **SSPC SP 1** and brush blasted per **SSPC SP 7** using Star Blast X-11 with compressed air pressure 40 to 60 psi.

<u>Topcoat (Type)</u>	<u>Manufacturer</u>
741 (SB) (IOT)	PPG Industries, Inc. One PPG Place Pittsburgh, PA 15272 (800) 722-4509 <a href="http://ppgamercoatus.ppgpmc.com">ppgamercoatus.ppgpmc.com</a>
Carbozinc Finish (SB) (IOT)	Carboline Co. 2150 Schuetz Road (314) 644-1000 <a href="http://www.carboline.com">www.carboline.com</a>
Carbozinc Finish (SB) (IOT)	
Devram 702 (SB) (IOT)	ICI Devco Coatings 4000 Dupont Circle Louisville, KY 40207 (800) 654-2616 <a href="http://www.devoecoatings.com">www.devoecoatings.com</a>
Intertherm 181 (SB) (IOT)	International Paint 6001 Antoine Dr. Houston, TX 77091 (713) 682-1711 <a href="http://www.international-pc.com">www.international-pc.com</a>
L03 (SB) (IOT)	Sherwin-William 101 Prospect Ave. Cleveland, OH 44115 (800) 336-1110 <a href="http://www.sherwin-williams.com">www.sherwin-williams.com</a>

## COATING SYSTEM NO. 3



Coating System No. 3 shall consist of an inhibitive polyamide epoxy tie coat, and [Aliphatic Polyurethane](#) finish coat. Coatings shall be selected from the following listing and all coatings, thinners, and cleaners shall be the product of the same manufacturer. Each successive coating shall be of a contrasting color to provide a visual assurance of complete coverage.

Section I. Materials with Greater than 400 Grams/Liter (3.3 Pounds/Gallon) VOC (SB is Solvent-Based and WB is Water-Based):

<u>Tiecoat (Type)</u>	<u>Topcoat (Type)</u>	<u>Manufacturer</u>
Devran 201 (SB)	Devthane 359 (SB)	ICI Devoe Coatings Co. 4000 Dupont Circle Louisville, KY 40207 (800) 654-2616 <a href="http://www.devoecoatings.com">www.devoecoatings.com</a>
Devran 230 (SB)	Devthane 369 (SB)	
Devran 201 (SB)	Devthane 369 (SB)	

Section II. Materials with Less than 400 Grams/Liter (3.3 Pounds/Gallon) VOC (SB is Solvent-Based and WB is Water-Based):

<u>Tiecoat (Type)</u>	<u>Topcoat (Type)</u>	<u>Manufacturer</u>
Amerlock 400 (SB) N/A	Amercoat 450S (SB) PSX700 (SB)	Ameron P.C.F.G. 210 North Berry St. Brea, CA 92821 (800) 926-3766 <a href="http://www.ameron.intl.com">www.ameron.intl.com</a>
Amercoat 383 (SB)	PSX101 (SB)	
Carboguard 893 (SB)	Carbothane 134HS (SB)	Carboline Company 350 HanleyIndustrialCt. St. Louis, MO 63114 (800) 677-0753 <a href="http://www.carboline.com">www.carboline.com</a>
Carbomastic 15 (SB)	Carboacrylic 3359 (WB)	
Cargoguard 893 (SB)	Carboxane 2000 (SB)	
Devran 201H (SB)	Devthane 379 (SB)	ICI Devoe Coatings Co. 4000 Dupont Circle Louisville, KY 40207 (800) 654-2616 <a href="http://www.devoecoatings.com">www.devoecoatings.com</a>
Macropoxy 646-100	Hi-Solids Polyurethane 250	
Interseal 670HS (SB)	Interfine 979 (SB)	International Paint 6001 Antoine Dr. Houston, TX 77091 (713) 682-1711 <a href="http://www.international-pc.com">www.international-pc.com</a>
Interseal 670HS (SB)	Interfine 878 (SB)	

COATING SYSTEM NO. 4

Coating System No. 4 shall consist of a [non-skid coating](#) system applied to steel floor surfaces subject to personnel traffic and equipment carts.

Approved Non-skid Coatings shall meet MIL-PRF-24667, Type 1, as available from American Safety Technologies, Inc., 565 Eagle Rock Avenue, Roseland, NJ 07068, telephone (800) 631-7841, [www.astantislip.com](http://www.astantislip.com), or approved equal (Primer MS-7C, Topcoat MS 400G, Color Topping MS-200).

<u>Primer</u>	<u>Non-skid</u>	<u>Manufacturer</u>
MS-7C7	AS-2300 SCILTC	American Safety Technologies, Inc.

- Type 1 - High Durability, rollable deck coating
- Composition G - General use abrasive deck system
- Non-Skid coating shall conform to MIL-PRF-24667

## PART 3 EXECUTION

### 3.1 SURFACE PREPARATION

#### 3.1.1 General

The on-site abrasive blasting and painting work shall require complete containment, collection and disposal of waste material in accordance with OSHA and local government and KSC environmental and safety regulations for handling hazardous materials and personnel protection.

The Contractor shall submit a plan and procedure for approval by the Contracting Officer for the protection of personnel and the environment during abrasive blasting and painting. The submittal shall describe materials, equipment and instrumentation used for compliance to contain, collect and dispose of waste materials in accordance with OSHA and the local authority.

Faying surfaces that will become inaccessible after installation shall be abrasive blasted and coated with inorganic zinc only, prior to installation.

Surfaces that are part of slip-critical joints shall be abrasive blasted and coated with inorganic zinc only prior to installation.

Surfaces to be welded shall be masked off and left uncoated. After installation by completion of field welding, all uncoated surfaces shall be cleaned and painted in accordance with paragraph 3.3.

Surfaces shall be inspected and degreased as required prior to subsequent surface preparation and the application of protective coatings. Degreasing shall be by solvent cleaning, detergent washing, or steam cleaning. SSPC SP 1 shall apply for solvent cleaning.

Immediately after the surface to be coated has been prepared, it will be inspected by the NACE Inspector to determine compliance with the specification for surface preparation. Any areas not meeting the surface preparation requirements shall be re-cleaned until approved. No coatings shall be applied until the surface preparation has been approved.

Prepared surfaces shall be coated within 6 hours after completion of surface preparation and before rusting or recontamination occurs. Surfaces not coated within 6 hours or which show rusting or contamination, regardless of the length of time after preparation, shall be reprepared.

Fastener holes shall be treated as uncoated surfaces and shall be coated in accordance with this specification.

Surface preparation and coating operations shall be sequenced so that freshly applied coatings will not be contaminated by dust or foreign matter.

### 3.1.2 Colors

Inorganic zinc coatings shall be pigmented so that there is a definite contrast between the coating and the dull gray appearance of the blasted steel surface during the coating application. Color coding for fluid system piping shall be in accordance with **KSC-STD-SF-0004**. Finish coat colors specified in paragraph 3.6 shall be in accordance with **FED-STD 595** color numbers using pigments free of lead, chromium and cadmium.

### 3.1.3 Abrasive Blasting (AB)

Abrasive blasting shall conform to **SSPC SP 10**.

Compressed air used for abrasive blasting shall be free of moisture and oil.

Surfaces not to be blasted are:

Prefinished surfaces except when specified to be blast-cleaned in the coating schedule

Piston rods and bearing surfaces

A minimum nozzle pressure of **90 pounds per square inch** shall be maintained.

Weld slag, weld spatter, and foreign matter shall be removed from surfaces to be coated prior to abrasive blasting using mechanical methods as specified.

Blast cleaning shall achieve a **1.5-to 3.0-mil** anchor profile as indicated by a surface profile comparator, replica tape, or similar device.

Rust and corrosion shall be removed from pits and depressions.

Abrasive blast aggregate shall not be reused.

All traces of abrasive residue and dust shall be removed from the surface, leaving it clean and dry.

### 3.1.4 Mechanical Cleaning (MC)

Where mechanical cleaning is specified required, needle scalers or abrasive disks or wheels shall be used in accordance with **SSPC SP 3** and **SSPC SP 11**, leaving the surface anchor profile of the surface cleaned with the power tool equal to 1.5 mil to 3.0 mil. All rust shall be completely removed from pits and depressions.

## 3.2 INSPECTION OF SURFACE PREPARATION

Immediately after the surface has been prepared, it will be inspected by the NACE inspector to determine compliance with the specification for surface preparation. Any areas not meeting the surface preparation requirements shall be re-cleaned until approved. No coatings shall be applied until the surface preparation has been approved.

### 3.3 COATING APPLICATION

Application and handling characteristics of all coatings will vary. To obtain optimum performance, adequate instructions from the manufacturer are essential and must be closely followed, in conjunction with the requirements of this specification.

Manufacturer's recommendations for thinning, mixing, handling, and applying his product shall be considered a part of this specification. In the event of conflict between the requirements of this specification and the manufacturer's recommendations, this specification shall take precedence.

Compressed air used for spraying coatings shall be free of moisture and oil.

Each coat of material applied shall be free from runs, sags, blisters, bubbles, variations in color, gloss and texture, holidays (missed areas), excessive film build, foreign contaminants, dry overspray, etc.

All coatings shall be thoroughly worked into all joints, crevices, and open spaces. Special attention shall be paid to welds, cutouts, sharp edges, rivets, crevices and bolts to ensure proper coverage and thickness.

All newly coated surfaces shall be adequately protected from damage. Special attention shall be paid to potential damage resulting from nearby operations such as grinding, welding, cutting, etc. Metal fittings that result from such activity shall not remain on coated surfaces. Any damage to coatings resulting from such operations shall be cleaned and touched-up per paragraph 3.3 of this section.

Apply all coatings by airless spray, conventional spray, or by brush. Airless spray shall be used for large surface areas. Conventional spray and brushes may be used for small areas of intricate configuration and touchup. During application of inorganic zinc coating, maintain uniform suspension.

#### 3.3.1 Weather Conditions

The ambient weather conditions at the actual location of the work shall be determined before and during the surface preparation and coating application operations to ensure they are correct for the work being conducted.

No coatings shall be applied when contamination from rainfall is imminent or when the temperature or humidity is outside limits recommended by the coating manufacturer. To prevent moisture condensation during application, surface temperature must be at least 3 degrees Celsius (5 degrees Fahrenheit) above the dewpoint. Wind speed shall not exceed 25 kilometers per hour (15 miles per hour) in the immediate coating area when using spray application methods.

Proper instrumentation shall be used to measure air temperature, relative humidity, dewpoint, surface temperature, and wind speed and direction.

All ambient weather conditions shall be recorded in the daily inspection reports.

Solvent-based inorganic zinc coatings, polysiloxane topcoats, and IOTs shall not be applied in conditions with <40 percent RH.

Water-based inorganic zinc coatings shall not be applied in conditions with <40 percent or >80 percent RH.

### 3.3.2 Mixing and Application Procedures

Material shall be stirred thoroughly using a instrument that will not induce air into coating.

Strain the mixed material through a 30 to 60 mesh screen.

Provide continuous slow agitation during application to maintain uniform suspension. Avoid continuous rapid agitation.

Thin for workability and improved spray characteristics only. Use only the manufacturers' recommended thinner and amount.

Adjust spray equipment to produce an even wet coat with minimum overspray.

Apply in even parallel passes, overlapping 50 percent to provide complete and uniform coverage. Pay special attention to welds, cut-outs, sharp edges, rivets, crevices, and bolts to ensure proper coverage.

Pressure pot, when used, shall be kept at the same level or above the spray gun for proper material delivery.

### 3.3.3 Dry-Film Thickness (DFT)

Coatings shall be applied to the following dry-film thicknesses:

#### Coating System No. 1:

Inorganic zinc	4.0 to 6.0 mils
----------------	-----------------

#### Coating System No. 2:

Hot Dipped Galvanized	ASTM A 123
Inorganic Topcoat	4.0 to 5.0 mils

#### Coating System No. 3:

Inhibitive Polyimide Epoxy	Per Mfg's recommendation
Aliphatic Polyurethane	Per Mfg's recommendation

#### Coating System No. 4:

Heavy Duty Metal Primer	Per Mfg's recommendation
2-part epoxy with premixed aggregate	Per Mfg's recommendation

When dry through (dry to handle), the film thickness shall be checked with a calibrated nondestructive dry-film thickness gage. If less than specified thickness, additional material shall be applied as required. Proper DFT for the inorganic zinc coating shall be obtained in a single application which may consist of multiple passes, while coating is still wet.

### 3.4 TOUCH-UP AND REPAIR

Touch-up shall be required of all damaged coatings that occur during shipment and field handling. During the construction work, touch-up shall be an on-going process to repair coatings that are damaged and expose steel surfaces to the elements. Field welds shall be cleaned, painted and inspected promptly to avoid rust formation.

Repair surfaces shall be prepared for coatings by water washing and by mechanical methods to [SSPC SP 11](#) to a roughness profile of 1.5 mils to remove corrosion and weld slag to bare metal. All chipped, peeling, or blistered paint shall be removed prior to touch-up. Repair coatings shall be "feathered in" to adjacent existing coating edges. Touched-up areas shall blend in with the surrounding area.

The following general touch-up requirements shall apply:

<u>COATING SYSTEM</u>	<u>TOUCH UP COATING</u>
<u>Coating System No. 1:</u> Inorganic zinc	Inorganic zinc
<u>Coating System No. 2:</u> Hot Dipped Galvanized Inorganic Topcoat	Inorganic zinc Inorganic topcoat
<u>Coating System No. 3:</u> Inhibitive Polymide Epoxy Aliphatic Polyurethane	Inhibitive Epoxy Aliphatic Polyurethane

Touch-up of damaged coatings shall be to the quality of the original finish coat. Contractor is responsible to protect the finish of all factory finishes and G.F.E. Should damage to these coating(s) be identified, the Contractor shall provide reasonable protection to prevent further damage. The Contractor shall submit a [Coating Repair Plan](#) for each damaged item. The plan shall include a proposed coating system, the location(s) of coating damage and proposed method of repair.

Coating System No. 4:  
Final appearance and distribution of aggregate texture shall be uniform across the entire surface.

### 3.5 SEALANT COMPOUND APPLICATION

Caulking shall be accomplished after application and cure of inorganic zinc coating and prior to application of topcoats.

Exterior joints shall be calked to seal all crevices against intrusion of water, including, but not limited to, the following:

- a. Perimeter of faying and bearing surfaces of structural members
- b. Joints in members between intermittent welds
- c. Perimeter of bearing surfaces between floor plates and supporting members (inside, outside, top, and bottom)
- d. Stair treads, where joined to channel stringers
- e. Openings of [1/2 inch](#) or smaller (Foam filler backup shall be used as required.)
- f. Hot-dipped galvanized vent holes

### 3.6 INSPECTION

On-site and off-site work as described herein shall be inspected for compliance with this specification by an independent third party NACE (National Association of Corrosion Engineers) Certified Coating Inspector Level 3 provided by the Contractor.

The NACE Certified Coating Inspector shall be present at the pre-work conference and shall submit a [Coating Inspector Plan](#) (CIP) specifically applicable to this project. The program shall include both off-site and on-site work.

The Coating Inspector Plan shall include, as a minimum, the following:

1. Basic inspection plan for determining compliance with the coating requirements in this section.
2. Inspection Forms which shall identify the key inspection intervals, activities and steps witnessed, inspected, tested and certified for this project.
3. The inspection plan for identifying areas and surfaces damaged during handling, erection and construction activities. Non-conformance reports are required to be signed and submitted to the Contracting Officer within 1 workday from the time that it is written. Once nonconformations have been corrected, complete a conformance verification report for the specific item or area.
4. Inspection and certifying repairs to damaged areas and surfaces.
5. Submittal schedule for issuing inspection reports. Signed, daily [Inspection reports](#) shall be submitted on a weekly basis as a minimum.
6. Non-conformance plan detailing expected coating failures and repairs, as well as sample reports.

Structural assemblies painted offsite and delivered onsite shall require the following:

1. Submittal of the certified [daily inspection reports](#) for each item.
2. Spot check a minimum of 10% of surface areas on each item delivered for compliance with the specifications. The government reserves the right to select the areas.
3. 10% of the surface areas shall be divided into 3 separate locations for spot checks.
4. Deficiencies greater than 10% shall require that the assembly be returned to the offsite facility for rework to comply with the specifications.

### 3.7 COATING SCHEDULE

<u>SURFACE DESCRIPTION</u>	<u>SURFACE PREPARATION SSPC</u>	<u>COATING SYSTEM</u>	<u>FINISH COLOR</u>	<u>DRY-FILM THICKNESS</u>
Structural Steel	SP-10	1	Gray	IZ 4.0 to 6.0 mils
Fixed Guardrails	SP-10	1	Gray	IZ 4.0 to 6.0 mils
Galvanized Conduit & Pipe	SP-1, SP-7	2	Gray	IOT 4.0 to 5.0 mils
All Uncoated Stainless Steel Surfaces	SP-7	3	Gray 16187*	Per Mfg's recommendations
Selected Steel, as shown on the drawings	SP-10	3	Yellow 13951	Per Mfg's recommendations
Walking Surfaces	SP-10	4	Gray	Per Mfg's recommendations

\*FED STD-595 Color Identification Number  
 -- End of Section --



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## DIVISION 10 - SPECIALTIES

## SECTION 10 14 00.20

## INTERIOR SIGNAGE

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- 1.3 QUALITY ASSURANCE
  - 1.3.1 Samples
  - 1.3.2 Detail Drawings
- 1.4 DELIVERY, STORAGE, AND HANDLING
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## PART 2 PRODUCTS

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- 2.3 FABRICATION AND MANUFACTURE
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## SECTION 10 14 00.20

## INTERIOR SIGNAGE

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

36 CFR 1191

Americans with Disabilities Act (ADA)  
Accessibility Guidelines for Buildings and  
Facilities; Architectural Barriers Act  
(ABA) Accessibility Guidelines

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00  
SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G

SD-03 Product Data

Installation; G  
Warranty; G

SD-04 Samples

Interior Signage; G

## 1.3 QUALITY ASSURANCE

## 1.3.1 Samples

Submit interior signage samples of each of the following sign types showing typical quality, workmanship and color: Directional sign. The samples may be installed in the work, provided each sample is identified and location recorded.

## 1.3.2 Detail Drawings

Submit detail drawings showing elevations of each type of sign, dimensions, details and methods of mounting or anchoring, mounting height, shape and thickness of materials, and details of construction. Include a schedule showing the location, each sign type, and message.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

Materials shall be packaged to prevent damage and deterioration during shipment, handling, storage and installation. Product shall be delivered to the jobsite in manufacturer's original packaging and stored in a clean, dry area in accordance with manufacturer's instructions.

#### 1.5 WARRANTY

Warrant the interior signage for a period of 2 years against defective workmanship and material. Warranties shall be signed by the authorized representative of the manufacturer. Submit warranty accompanied by the document authenticating the signer as an authorized representative of the guarantor. Guarantee that the signage products and the installation are free from any defects in material and workmanship from the date of delivery.

### PART 2 PRODUCTS

#### 2.1 STANDARD PRODUCTS

Signs shall be the standard product of a manufacturer regularly engaged in the manufacture of such products that essentially duplicate signs that have been in satisfactory use at least 2 years prior to bid opening. Obtain signage from a single manufacturer with edges and corners of finished letterforms and graphics true and clean.

#### 2.2 SIGNAGE

##### 2.2.1 Load Rating Signs

Painted aluminum .063" gauge, with 1 inch radius corners. Lettering in 3M Scotchlite Hi Intensity vinyl sheeting, or approved equal, white reflective.

##### 2.2.2 Type of Mounting For Signs

Mounting shall be by mechanical fasteners.

#### 2.3 FABRICATION AND MANUFACTURE

##### 2.3.1 Factory Workmanship

Holes for bolts and screws shall be drilled or punched. Drilling and punching shall produce clean, true lines and surfaces. Exposed surfaces of work shall have a smooth finish and exposed riveting shall be flush. Fastenings shall be concealed where practicable.

##### 2.3.2 Dissimilar Materials

Where dissimilar metals are in contact, the surfaces will be protected to prevent galvanic or corrosive action.

#### 2.4 COLOR, FINISH, AND CONTRAST

Color shall be as indicated. Finish of all signs shall be eggshell, matte, or other non-glare finish as required in handicapped-accessible buildings.

#### 2.5 TYPEFACE

Helvetica Regular.

## PART 3 EXECUTION

## 3.1 INSTALLATION

Signs shall be installed plumb and true and in accordance with approved manufacturer's instructions at locations shown on the detail drawings . Mounting height and mounting location shall conform to 36 CFR 1191. Required blocking shall be installed.

## 3.1.1 Anchorage

Anchorage shall be in accordance with approved manufacturer's instructions. Anchorage not otherwise specified or shown shall include machine carriage bolts for steel. Exposed anchor and fastener materials shall be compatible with metal to which applied and shall have matching color and finish.

## 3.1.2 Protection and Cleaning

Protect the work against damage during construction.

-- End of Section --

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## DIVISION 26 - ELECTRICAL

## SECTION 26 00 00.00 20

## BASIC ELECTRICAL MATERIALS AND METHODS

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- 1.3 DEFINITIONS
- 1.4 ELECTRICAL CHARACTERISTICS
- 1.5 ADDITIONAL SUBMITTALS INFORMATION
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  - 1.5.2 Product Data (SD-03)
- 1.6 QUALITY ASSURANCE
  - 1.6.1 Regulatory Requirements
  - 1.6.2 Standard Products
    - 1.6.2.1 Alternative Qualifications
    - 1.6.2.2 Material and Equipment Manufacturing Date
- 1.7 WARRANTY
- 1.8 POSTED OPERATING INSTRUCTIONS
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## PART 2 PRODUCTS

- 2.1 FACTORY APPLIED FINISH

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- 3.1 FIELD APPLIED PAINTING
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## SECTION 26 00 00.00 20

## BASIC ELECTRICAL MATERIALS AND METHODS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

## ASTM INTERNATIONAL (ASTM)

ASTM D709 (2001; R 2007) Laminated Thermosetting Materials

## INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100 (2000; Archived) The Authoritative Dictionary of IEEE Standards Terms

IEEE C2 (2012; Errata 2012; INT 1 2012; INT 2 2012) National Electrical Safety Code

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (2008) Enclosures for Electrical Equipment (1000 Volts Maximum)

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2011; Errata 2 2012) National Electrical Code

## 1.2 RELATED REQUIREMENTS

This section applies to all sections of Division 26 and 28, ELECTRICAL AND ELECTRONIC SAFETY AND SECURITY, of this project specification unless specified otherwise in the individual sections.

## 1.3 DEFINITIONS

- a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.
- b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.
- c. The technical paragraphs referred to herein are those paragraphs in PART 2 - PRODUCTS and PART 3 - EXECUTION of the technical sections that describe products, systems, installation procedures, equipment, and test methods.

#### 1.4 ELECTRICAL CHARACTERISTICS

Electrical characteristics for this project shall be 480V volts secondary, three phase, four wire. Final connections to the power distribution system at the existing substation shall be made by the Contractor as directed by the Contracting Officer.

#### 1.5 ADDITIONAL SUBMITTALS INFORMATION

Submittals required in other sections that refer to this section must conform to the following additional requirements as applicable.

##### 1.5.1 Shop Drawings (SD-02)

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

##### 1.5.2 Product Data (SD-03)

Submittal shall include performance and characteristic curves.

#### 1.6 QUALITY ASSURANCE

##### 1.6.1 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

##### 1.6.2 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in the technical section.

##### 1.6.2.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than

6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

#### 1.6.2.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

#### 1.7 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

#### 1.8 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

- a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
- b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.
- c. Safety precautions.
- d. The procedure in the event of equipment failure.
- e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

#### 1.9 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

#### 1.10 FIELD FABRICATED NAMEPLATES

**ASTM D709.** Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.



### 1.11 ELECTRICAL REQUIREMENTS

Electrical installations shall conform to IEEE C2, NFPA 70, and requirements specified herein.

### 1.12 INSTRUCTION TO GOVERNMENT PERSONNEL

Where specified in the technical sections, furnish the services of competent instructors to give full instruction to designated Government personnel in the adjustment, operation, and maintenance of the specified systems and equipment, including pertinent safety requirements as required. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section.

## PART 2 PRODUCTS

### 2.1 FACTORY APPLIED FINISH

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test and the additional requirements specified in the technical sections.

## PART 3 EXECUTION

### 3.1 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in the section specifying the associated electrical equipment.

### 3.2 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

-- End of Section --

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## DIVISION 26 - ELECTRICAL

## SECTION 26 05 00.00 40

## COMMON WORK RESULTS FOR ELECTRICAL

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- 1.5 GENERAL REQUIREMENTS
- 1.6 POSTED OPERATING INSTRUCTIONS
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## PART 2 PRODUCTS

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  - 2.1.3 Wireways and Auxiliary Gutters
- 2.2 WIRE AND CABLE
- 2.3 SPLICES AND CONNECTORS
- 2.4 SWITCHES
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  - 2.4.2 Toggle Switches
- 2.5 RECEPTACLES
- 2.6 OUTLETS, OUTLET BOXES, AND PULL BOXES
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## PART 3 EXECUTION

- 3.1 CONDUITS, RACEWAYS AND FITTINGS
  - 3.1.1 Rigid Steel Conduit
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- 3.2 WIRING
- 3.3 SAFETY SWITCHES
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## SECTION 26 05 00.00 40

## COMMON WORK RESULTS FOR ELECTRICAL

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## ASTM INTERNATIONAL (ASTM)

ASTM D709 (2001; R 2007) Laminated Thermosetting Materials

## ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA 480 (1981) Toggle Switches

## INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE Stds Dictionary (2009) IEEE Standards Dictionary: Glossary of Terms & Definitions

## INTERNATIONAL CODE COUNCIL (ICC)

ICC/ANSI A117.1 (2009) Accessible and Usable Buildings and Facilities

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI Z535.1 (2006; R 2011) American National Standard for Safety--Color Code

ANSI/NEMA OS 1 (2008; Amd 2010) Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports

NEMA FB 1 (2012) Standard for Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable

NEMA KS 1 (2001; R 2006) Enclosed and Miscellaneous Distribution Equipment Switches (600 V Maximum)

NEMA WD 6 (2002; R 2008) Wiring Devices Dimensions Specifications

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2011; Errata 2 2012) National Electrical Code

## UNDERWRITERS LABORATORIES (UL)

UL 1	(2005; Reprint Jul 2007) Standard for Flexible Metal Conduit
UL 489	(2009; Reprint Jun 2011) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 6	(2007; reprint Nov 2010) Electrical Rigid Metal Conduit-Steel
UL 870	(2008) Standard for Wireways, Auxiliary Gutters, and Associated Fittings

## 1.2 DEFINITIONS

- a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in [IEEE Stds Dictionary](#).
- b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section [01 33 00](#)

SUBMITTAL PROCEDURES:

[SD-01 Preconstruction Submittals](#)

Submit [Material, Equipment, and Fixture Lists](#) for the following:

[Conduits, Raceway sand Fittings](#)

[Wire and Cable](#)

[Splices and Connectors](#)

[Switches](#)

[Receptacles](#)

[Outlets, Outlet Boxes, and Pull Boxes](#)

[Circuit Breakers; G](#)

[SD-03 Product Data](#)

Submit manufacturer's catalog data for the following items:

[Conduits, Raceway sand Fittings](#)

[Wire and Cable](#)

Splices and Connectors

Switches

Receptacles

Outlets, Outlet Boxes, and Pull Boxes

Circuit Breakers; G

Spare Parts

Certification

SD-06 Test Reports

Continuity Test

Phase-Rotation Tests

Insulation Resistance Test

SD-08 Manufacturer's Instructions

Submit [Manufacturer's Instructions](#).

#### 1.4 PREVENTION OF CORROSION

Protect metallic materials against corrosion. Provide equipment enclosures with the standard finish by the manufacturer when used for most indoor installations. For harsh indoor environments (any area subjected to chemical and/or abrasive action), and all outdoor installations, refer to Section [09 90 00.00 98](#) PAINTING AND COATING. Do not use aluminum when in contact with earth or concrete and, where connected to dissimilar metal, protect by approved fittings and treatment. Ferrous metals such as, but not limited to, anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous [spare parts](#) not of corrosion-resistant steel shall be hot-dip galvanized except where other equivalent protective treatment is specifically approved in writing.

#### 1.5 GENERAL REQUIREMENTS

Submit [material, equipment, and fixture lists](#) for the following items showing manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site.

Submit [manufacturer's instructions](#) including special provisions required to install equipment components and system packages. Special notices shall detail impedances, hazards and safety precautions.

Submit [certification](#) required to install equipment components and system packages.

#### 1.6 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

- a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
- b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.
- c. Safety precautions.
- d. The procedure in the event of equipment failure.
- e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and be secured to prevent easy removal or peeling.

#### 1.7 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

#### 1.8 FIELD FABRICATED NAMEPLATES

**ASTM D709.** Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, **0.125 inch** thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be **one by 2.5 inches**. Lettering shall be a minimum of **0.25 inch** high normal block style.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

Materials and equipment to be provided shall be the standard cataloged products of manufacturers regularly engaged in the manufacture of the products.

##### 2.1.1 Rigid Steel Conduit

Rigid steel conduit shall comply with **UL 6** and be galvanized by the hot-dip process.

Fittings for rigid steel conduit shall be threaded.

Gaskets shall be solid. Conduit fittings with blank covers shall have gaskets, except in clean, dry areas or at the lowest point of a conduit run where drainage is required.

Covers shall have captive screws and be accessible after the work has been completed.

#### 2.1.2 Flexible Metallic Conduit

Metallic conduit shall comply with [UL 1](#) and be galvanized steel.

Provide liquidtight flexible metallic conduit with a protective jacket of PVC extruded over a flexible interlocked galvanized steel core to protect wiring against moisture, oil, chemicals, and corrosive fumes.

Specifically design fittings for liquidtight flexible metallic conduit for such conduit.

#### 2.1.3 Wireways and Auxiliary Gutters

Wireway and auxiliary gutters shall be a minimum 4- by 4 inch trade size conforming to [UL 870](#).

### 2.2 WIRE AND CABLE

Conductors installed in conduit shall be copper 600-volt type THHN or XHHW as indicated. All conductors [AWG No. 8](#) and larger, shall be stranded. All conductors smaller than [AWG No. 8](#) shall be solid.

Flexible cable shall be Type SO and contain a grounding conductor with green insulation.

Control wires shall be stranded copper 600V THWN or MTW.SIS wire is acceptable in factory-wired cabinets.

### 2.3 SPLICES AND CONNECTORS

Make all splices in [AWG No. 8](#) and smaller with approved insulated electrical type.

Make all splices in [AWG No. 6](#) and larger with indentor crimp-type connectors and compression tools. Joints shall be wrapped with an insulating tape that has an insulation and temperature rating equivalent to that of the conductor.

### 2.4 SWITCHES

#### 2.4.1 Safety Switches

Safety switches shall comply with [NEMA KS 1](#), and be the heavy-duty type with enclosure, voltage, current rating, number of poles, and fusing as indicated. Switch construction shall be such that, when the switch handle in the "ON" position, the cover or door cannot be opened. Cover release device shall be coinproof and be so constructed that an external tool shall be used to open the cover. Make provisions to lock the handle in the "OFF" position, but the switch shall not be capable of being locked in the "ON" position.

Provide switches of the quick-make, quick-break type. Approve terminal lugs for use with copper conductors.

Safety color coding for identification of safety switches shall conform to [ANSI Z535.1](#).

#### 2.4.2 Toggle Switches

Toggle switches shall comply with EIA 480, control incandescent, mercury, and fluorescent lighting fixtures and be of the heavy duty, general purpose, noninterchangeable flush-type.

Toggle switches shall be commercial grade toggle type, single double-pole, three-way two-position devices (as indicated) rated 20 amperes at 277 volts, 60 hertz alternating current (ac) only.

All toggle switches shall be products of the same manufacturer.

#### 2.5 RECEPTACLES

Receptacles shall be commercial grade, 20A, 125 VAC, 2-pole, 3-wire duplex conforming to NEMA WD 6, NEMA 5-20R.

Special purpose receptacles shall be as indicated.

#### 2.6 OUTLETS, OUTLET BOXES, AND PULL BOXES

Outlet boxes for use with conduit systems shall be in accordance with NEMA FB 1 and ANSI/NEMA OS 1 and be not less than 1-1/2 inches deep. Furnish all pull and junction boxes with screw-fastened covers.

#### 2.7 CIRCUIT BREAKERS

Circuit-breaker interrupting rating shall be not less than those indicated and in no event less than 10,000 amperes root-mean-square (rms) symmetrical at 208 volts, respectively. Multipole circuit breakers shall be the common-trip type with a single handle. Molded case circuit breakers shall be bolt-on type conforming to UL 489.

### PART 3 EXECUTION

#### 3.1 CONDUITS, RACEWAYS AND FITTINGS

Conduit runs between outlet and outlet, between fitting and fitting, or between outlet and fitting shall not contain more than the equivalent of three 90-degree bends, including those bends located immediately at the outlet or fitting.

Do not install crushed or deformed conduit. Avoid trapped conduit runs where possible. Take care to prevent the lodgment of foreign material in the conduit, boxes, fittings, and equipment during the course of construction. Clear any clogged conduit of obstructions or be replaced.

##### 3.1.1 Rigid Steel Conduit

Make field-made bends and offsets with approved hickey or conduit bending machine. Conduit elbows larger than 2-1/2 inches shall be long radius.

Provide all conduit stubbed-up through concrete floors for connections to free-standing equipment with the exception of motor-control centers, cubicles, and other such items of equipment, with a flush coupling when the floor slab is of sufficient thickness. Otherwise, provide a floor box set flush with the finished floor. Conduits installed for future use shall be terminated with a coupling and plug set flush with the floor.



### 3.1.2 Flexible Metallic Conduit

Use flexible metallic conduit to connect recessed fixtures from outlet boxes in ceilings, transformers, and other approved assemblies.

Bonding wires shall be used in flexible conduit as specified in NFPA 70, for all circuits. Flexible conduit shall not be considered a ground conductor.

Electrical connections to vibration-isolated equipment shall be made with flexible metallic conduit.

Liquidtight flexible metallic conduit shall be used in wet and oily locations and to complete the connection to motor-driven equipment.

### 3.1.3 Wireway and Auxiliary Gutter

Straight sections and fittings shall be bolted together to provide a rigid, mechanical connection and electrical continuity. Dead ends of wireways and auxiliary gutters shall be closed. Plug all unused conduit openings.

Auxiliary gutters used to supplement wiring spaces for equipment not contained in a single enclosure shall contain no switches, overcurrent devices, appliances, or apparatus and be not more than 30 feet long.

## 3.2 WIRING

Feeder and branch circuit conductors shall be color coded as follows:

<u>CONDUCTOR</u>	<u>120/208VAC</u> <u>COLOR</u>	<u>277/480VAC</u> <u>COLOR</u>
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White	Natural Gray
Equipment Grounds	Green	Green

Conductors up to and including AWG No. 2 shall be manufactured with colored insulating materials. Conductors larger than AWG No. 2 shall have ends identified with color plastic tape in outlet, pull, or junction boxes.

Splice in accordance with the NFPA 70. Provide conductor identification within each enclosure where a tap, splice, or termination is made and at the equipment terminal of each conductor. Terminal and conductor identification shall match as indicated.

Where several feeders pass through a common pullbox, the feeders shall be tagged to clearly indicate the electrical characteristics, circuit number, and panel designation.

### 3.3 SAFETY SWITCHES

Securely fasten switches to the supporting structure or wall, utilizing a

minimum of four 1/4 inch bolts. Do not use sheet metal screws and small machine screws for mounting. Do not mount switches in an inaccessible location or where the passageway to the switch may become obstructed. Mounting height shall be 5 feet above floor level, when possible.

### 3.4 WIRING DEVICES

#### 3.4.1 Wall Switches and Receptacles

Install wall switches and receptacles so that when device plates are applied, the plates will be aligned vertically to within 1/16 inch.

Ground terminal of each flush-mounted receptacle shall be bonded to the outlet box with an approved green bonding jumper when used with dry wall type construction.

#### 3.4.2 Device Plates

Device plates for switches that are not within sight of the loads controlled shall be suitably engraved with a description of the loads.

Device plates and receptacle cover plates for receptacles other than 125-volt, single-phase, duplex, convenience outlets shall be suitably marked, showing the circuit number, voltage, frequency, phasing, and amperage available at the receptacle. Required marking shall consist of a self-adhesive label having 1/4 inch embossed letters.

Device plates for convenience outlets shall be similarly marked indicating the supply panel and circuit number.

### 3.5 BOXES AND FITTINGS

Furnish and install pullboxes where necessary in the conduit system to facilitate conductor installation. Conduit runs longer than 100 feet or with more than three right-angle bends shall have a pullbox installed at a convenient intermediate location.

Securely mount boxes and enclosures to the building structure with supporting facilities independent of the conduit entering or leaving the boxes.

Mounting height of wall-mounted outlet and switch boxes, measured between the bottom of the box and the finished floor, shall be in accordance with ICC/ANSI A117.1 and as follows:

<u>LOCATION</u>	<u>MOUNTING HEIGHT</u>
Receptacles	48 inches
Switches for light control	48 inches

### 3.6 IDENTIFICATION PLATES AND WARNINGS

Furnish and install identification plates for lighting and power panelboards, motor control centers, all line voltage heating and ventilating control panels, fire detector and sprinkler alarms, door bells, pilot lights, disconnect switches, manual starting switches, and magnetic starters. Process control devices and pilot lights shall have identification plates.

Furnish identification plates for all line voltage enclosed circuit breakers, identifying the equipment served, voltage, phase(s) and power source. Circuits 480 volts and above shall have conspicuously located warning signs in accordance with OSHA requirements.

### 3.7 PAINTING

Exposed conduit, supports, fittings, cabinets, pull boxes, and racks shall be thoroughly cleaned and painted as specified in Section 09 97 13.00 98 STEEL COATINGS.

### 3.8 FIELD TESTING

Submit Test Reports in accordance with referenced standards in this section.

After completion of the installation and splicing, and prior to energizing the conductors, perform wire and cable continuity and insulation tests as herein specified before the conductors are energized.

Contractor shall provide all necessary test equipment, labor, and personnel to perform the tests, as herein specified.

Isolate completely all wire and cable from all extraneous electrical connections at cable terminations and joints. Substation and switchboard feeder breakers, disconnects in combination motor starters, circuit breakers in panel boards, and other disconnecting devices shall be used to isolate the circuits under test.

Perform [insulation-resistance test](#) on each field-installed conductor with respect to ground and adjacent conductors. Applied potential shall be 500 volts dc for 300 volt rated cable and 1000 volts dc for 600 volt rated cable. Take readings after 1 minute and until the reading is constant for 15 seconds. Minimum insulation-resistance values shall not be less than 25 Megohms for 300 volt rated cable and 100 Megohms for 600 volt rated cable. For circuits with conductor sizes 8AWG and smaller insulation resistance testing is not required.

Perform [continuity test](#) to insure correct cable connection (i.e correct phase conductor, grounded conductor, and grounding conductor wiring) end-to-end. Any damages to existing or new electrical equipment resulting from contractor mis-wiring will be repaired and re-verified at contractor's expense. All repairs shall be approved by the CO prior to acceptance of the repair.

Conduct [phase-rotation tests](#) on all three-phase circuits using a phase-rotation indicating instrument. Perform phase rotation of electrical connections to connected equipment clockwise, facing the source.

Final acceptance will depend upon the successful performance of wire and cable under test. Do not energize any conductor until the final test reports are reviewed and approved by the CO.

-- End of Section --

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## SECTION 26 05 63.00 98

## COORDINATED POWER SYSTEM PROTECTION AND ARC FLASH ANALYSIS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 1584 (2002, Am 1 2004, Int 1-3 2008) Guide for Performing Arc-Flash Hazard Calculations

IEEE 242 (2001; Errata 2003) Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems - Buff Book

IEEE 399 (1997) Brown Book IEEE Recommended Practice for Power Systems Analysis

IEEE C2 (2012; Errata 2012; INT 1 2012; INT 2 2012) National Electrical Safety Code

## INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS (2009) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA Z535.4 (2011) American National Standard for Product Safety Signs and Labels

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2011; Errata 2 2012) National Electrical Code

NFPA 70E (2012) Standard for Electrical Safety in the Workplace

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Fault Current and Arc Flash Analysis Review Submittals; G

Protective Device Coordination Study Review Submittals; G

Proposed Test Plan; G

#### SD-03 Product Data

Fault Current and Arc Flash Analysis; G

Protective Device Coordination Study; G

Equipment; G

System Coordinator; G

Protective Relays; G

Installation Procedures; G

#### SD-06 Test Reports

Field Testing; G

#### SD-07 Certificates

Certificates of Conformance for Devices and Equipment; G

### 1.3 ADMINISTRATIVE REQUIREMENTS

#### 1.3.1 Pre-Installation Submittals and Meetings

No later than 90 days after Contract Award, submit the following to the Contracting Officer for review and approval:

- a. Fault Current and Arc Flash Analysis Review Submittals
- b. Protective Device Coordination Study Review Submittals
- c. Proposed Test Plan

The Contractor and System Coordinator agree to attend a review meeting at a location designated by the Contracting Officer and provide review submittals as follows:

- a. 90 percent submittal and review meeting: Study is complete except for disposition of Government comments. Coordinate submittal date and review meeting with Contracting Officer.
- b. 100 percent submittal: Incorporates approved Government comments. Setting sheets and test procedures from these documents are to be used to implement protective device settings. Coordinate submittal and implementation of settings with Contracting Officer.

##### 1.3.1.1 Proposed Test Plan

Submit a proposed test plan, consisting of complete field test procedure including tests to be performed, test equipment required, and tolerance limits, including complete testing and verification of the ground fault

protection equipment, where used.

#### 1.3.1.2 Review and Final Submittals Format

For review and final submittals, submit 5 bound copies and a PDF file formatted on Compact Disc (CD) and or electronic storage media. Also provide on a final submittal CD all power system analysis software data files necessary to restore and edit the model.

Submit performance test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Indicate in each test report the final position of controls.

##### a. [Equipment data](#)

Submit data consisting of manufacturer's time-current characteristic curves for individual protective devices, recommended settings of adjustable protective devices, and recommended ratings of non-adjustable protective devices.

Review protective device submittals of equipment to be provided and indicate any options or modifications required to achieve the requirements of this section. No time extensions or similar contract modifications will be granted for work arising out of the requirements for this study. The Government is not responsible for any changes to equipment, device ratings, settings, or additional labor for installation of equipment or devices ordered and/or procured prior to approval of the study.

##### b. [Protective Relays](#)

Submit data including calibration and testing procedures and instructions pertaining to the frequency of calibration, inspection, adjustment, cleaning, and lubrication.

##### c. [Installation Procedures](#)

Submit written description of procedures including diagrams, instructions, and precautions required to properly install, adjust, calibrate, and test the devices and equipment.

#### 1.3.2 Final Submittals

After completion of installation and testing submit the following to the Contracting Officer for review and approval:

Field Test Results - Submit in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Indicate in each test report the final position of controls.

#### 1.3.3 Field Changes

If field changes are required due to discrepancies between the setting sheet documents and the available setting selections on the protective device, submit within 10 days after installation the following to the Contracting Officer for review and approval:



- a. Fault Current and Arc Flash Analysis
- b. Protective Device Coordination Study

#### 1.4 QUALITY ASSURANCE

Ensure all work performed is in conformance with the following standards:

IEEE C2

IEEE 1584

NEMA Z535.4

NETA ATS

NFPA 70

NFPA 70E

##### 1.4.1 System Coordinator

Provide documentation verifying that system coordination, recommended ratings and settings of protective devices, and design analysis are prepared (performed/reviewed/approved) by a registered professional electrical power engineer with a minimum of 3 years of current experience in the coordination of electrical power systems.

##### 1.4.2 System Installer

Ensure all final calibration, testing, adjustment, and placing into service of the protective devices is accomplished by a manufacturer's product field service engineer or independent testing company with a minimum of two years of current product experience in protective devices.

#### 1.5 RELATED REQUIREMENTS

Section 26 08 00 APPARATUS INSPECTION AND TESTING applies to this Section.

#### 1.6 PROJECT/SITE CONDITIONS

Provide devices and equipment suitable for the following site conditions:

- a. Altitude: 0'
- b. Ambient Temperature: 95 degrees F
- c. Frequency: 60 HZ
- e. Hazardous Classification: Refer to contract drawings: EH-001, EH-101 thru EH-128 and EH-301
- f. Humidity Control: 95%
- g. Ventilation: None

## PART 2 PRODUCTS

### 2.1 SYSTEM DESCRIPTION

The power system covered by this specification as shown on the drawings.

The Government will provide the short circuit values for the following connection points on the electrical system:

SS 811

SS 809

Others as required

The Government will provide the existing protective device settings for the following devices on the electrical system:

SS 811/5A

SS 811/6A

Others as required

### 2.2 ARC FLASH LABELS

Provide weatherproof detailed arc flash warning labels for all electrical equipment as required by NFPA 70 and NFPA 70E, including, medium voltage switches, transformers, switchgear main breakers, switchgear bus-tie breaker, switchgear feeder breakers, switchgear cable compartments, switchboards, panel boards, motor control centers, enclosed breakers, safety switches automatic transfer switches, motor starters, control panels, and other equipment modified or installed by the project that is likely to require examination, adjustment, servicing, or maintenance while energized.

#### 2.2.1 Label Format

Label format is to be NFPA 70E detailed format type. Conform in detail with samples provided at the time of award. Format includes different colors and formatting per NEMA Z535.4 for different hazard levels and the following information:

- a. Flash hazard boundary
- b. Incident energy
- c. Hazard Category and PPE
- d. Shock Voltage
- e. Minimum insulated glove rating
- f. Limited approach boundary distance
- g. Restricted approach boundary distance
- h. Prohibited approach boundary distance

### 2.2.2 Label Content

Ensure arc flash label content is based on the operational scenario, fault location, and fault type (arcing or bolted) that results in the highest incident energy.

## 2.3 COORDINATED POWER SYSTEM PROTECTION

Prepare and submit analyses to demonstrate that the equipment selected and system constructed meet the contract requirements for ratings, coordination, and protection. Include a [fault current and arc flash analysis](#), equipment evaluation report, and a [protective device coordination study](#). Submit Certificates of Conformance verifying that the studies have been prepared (performed/reviewed/approved) by a registered professional engineer with demonstrated experience in power system coordination in the last 3 years. Provide a list of references complete with points of contact, addresses and telephone numbers. The selection of the engineer is subject to the approval of the Contracting Officer.

Prepare and submit short circuit studies, load flow studies, motor starting analysis, coordination studies, and arc-flash hazard analysis in accordance with NETA ATS and as specified herein.

### 2.3.1 Scope of Analyses

Ensure the fault current and arc flash analysis, and protective device coordination study begin at:

The source bus and extend down to system buses where fault availability is 10,000 amperes (symmetrical) for building/facility 600 volt level distribution buses.

### 2.3.2 Determination of Facts

Perform field inspections to determine and document the time-current characteristics, features, and nameplate data for each existing protective device. Utilize the fault current availability provided by the government as a basis for fault current studies.

### 2.3.3 Single Line Diagram

Prepare a single line diagram to show the electrical system buses, devices, transformation points, and all sources of fault current (including generator and motor contributions). A fault-impedance diagram or a computer analysis diagram may be provided. Ensure each bus, device or transformation point has a unique identifier. If a fault-impedance diagram is provided, show impedance data. Show the location of switches, breakers, and circuit interrupting devices on the diagram together with available fault data, and the device interrupting rating.

### 2.3.4 Fault Current Analysis

#### 2.3.4.1 Method

Perform the fault current analysis in accordance with methods described in [IEEE 242](#), and [IEEE 399](#). Single line drawings based on existing hardware will be provided to the Contractor for reference. Utilize specialized computer aided engineering software designed for fault current analysis, including the following capabilities:

- a. Single-ended substation source operation
- b. Double-ended substation source operation
- c. Generator source operation

Perform analysis and provide separate study report generated for each operational scenario.

#### 2.3.4.2 Data

Utilize actual hardware data in fault calculations. Ensure bus characteristics and transformer impedance are those proposed. Document all data in the report.

#### 2.3.4.3 Fault Current Availability

Provide balanced three-phase fault, bolted line-to-line fault, and line-to-ground fault current values at each voltage transformation point and at each power distribution bus. Show the maximum and minimum values of fault available at each location in tabular form on the diagram or in the report.

#### 2.3.5 Coordination Study

Ensure the study demonstrates that the maximum possible degree of selectivity has been obtained between devices specified, consistent with protection of equipment and conductors from damage from overloads and fault conditions. Include a description of the coordination of the protective devices in this project. Provide a written narrative describing:

- a. Which devices may operate in the event of a fault at each bus; the logic used to arrive at device ratings and settings;
- b. Situations where system coordination is not achievable due to device limitations (an analysis of any device curves which overlap);
- c. Coordination between upstream and downstream devices; and relay settings.
- d. Provide recommendations to improve or enhance system reliability by reducing the incident energy level, and detail where such changes would involve additions or modifications to the contract and cost damages (addition or reduction).

Provide composite coordination plots on log-log graph paper.

- a. Provide separate plots for phase and ground faults.
- b. Include applicable cable and transformer damage curves on phase fault plots.
- c. Limit the number of protective device curves on any plot to 5.

#### 2.3.6 Study report

Include the following in the report:

- a. A cover sheet and table of contents. Provide separate sections with all applicable content, for all operating scenarios.
- b. A narrative describing:
  - (1) The analyses performed;
  - (2) The basis and methods used;
  - (3) The desired method of coordinated protection of the power system.
- c. Descriptive and technical data for existing devices and new protective devices proposed, including manufacturers published data, nameplate data, time-current curves, and definition of the fixed or adjustable features of the existing or new protective devices.
- d. Document utility data including system voltages, fault MVA, system X/R ratio, time-current characteristic curves, current transformer ratios, and relay device numbers and settings; and existing power system data including time-current characteristic curves and protective device ratings and settings.
- e. Provide time-current characteristics curves for each bus in the system, as required to ensure coordinated power system protection between protective devices or equipment, including recommended ratings and settings of all protective devices in tabulated form.
- f. Provide all calculations performed for the analyses, including computer analysis programs utilized, the name of the software package, developer, and version number. Include all information input to (define) nodes such as cable data, conduit type, circuit length, transformer impedance, bus impedance, generator impedances, etc. For all nodes include phase fault short circuit levels and X/R ratios, ground fault short circuit levels and X/R ratios, load flow levels, arc flash energy (for both bolted and arcing short circuit levels), and motor starting studying results. Indicate which study options have been chosen which the SKM software utilizes to generate the Short Circuit Analysis and Arc Flash Hazard Analysis results; use preferred method below when available. Options included are, but not limited to the following:
  - (1) Standard used for arc-flash calculations: (IEEE 1584 - preferred method).
  - (2) 240 Volt Exceptions (report Cat 0 if XFMR less than 125kVA - preferred method).
  - (3) Maximum arcing time: (2 sec - preferred - fully dependent on task performed). For certain tasks, such as working in manholes, elevated work areas, or underneath equipment, it may not be possible for trained personnel to distance themselves from the Arc Flash within 2 seconds.
  - (4) Motor fault contributions: (5 cycles preferred - motors with 50 hp or greater are to be evaluated).
  - (5) Levels Mis-coordination checked (5 levels-preferred).
  - (6) Mis-coordination Ratio: (80 percent - preferred - ensure Cleared

Fault Threshold matches Mis-coordination Ratio).

- (7) Flash Boundary Calculation Adjustments above 1kV, Trip Time less than =0.1s: (1.5 cal/square meter - preferred).
- (8) Properly categorize all equipment types in Arc Flash Evaluation: (Ensure switchgear, panel boards have proper gap distance).
- (9) Utility information from latest Area Load Flow and Fault Study (provided by the Governemnt -preferred).
- (10) Short Circuit Study Utilized: (Comprehensive-preferred).
- (11) Fault types analyzed: (Three Phase, Single Line to Ground, Line to Line, Line to Line to Ground, All -preferred).

g. Single line diagram(s)

- h. Protective device setting sheets, as separate pages, suitable for use by installing technicians, separate from other report analysis and data. Include recommended changes to existing protective device settings and settings for all new protective devices. Provide all information to field install the settings, including settings or features not used or turned off.
- i. Tabulated Arc Flash data for all equipment requiring an arc flash warning label and all modified equipment also requiring an arc flash label.
- j. Equipment Evaluation Report (EER) showing the AIC/SCCR ratings for all equipment evaluated and the required rating for the application where the equipment is installed. Ensure the EER identifies underrated and marginally rated equipment. Underrated equipment is defined as equipment with actual AIC/SCCR ratings that do not meet the required AIC/SCCR rating for the application/installation. Marginally rated equipment is defined as equipment within 90 percent to 100 percent of the required rated AIC/SCCR for the application/installation.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Install and test protective devices settings in accordance with the manufacturer's published instructions and in accordance with the protective device coordination study protective device setting sheets and test plan.

Affix detailed arc flash warning labels to all electrical equipment as required by NFPA 70 and NFPA 70E.

### 3.2 FIELD TESTING

#### 3.2.1 General

Section 26 08 00 APPARATUS INSPECTION AND TESTING, applies to this section with the additions and modifications specified herein. Submit Performance Test Reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Indicate in each test report the final position of

controls. Submit [Certificates of Conformance for Devices and Equipment](#) to the Contracting Officer, certifying that all devices or equipment meet the requirements of the contract documents.

### 3.2.2 Safety

Provide and use safety devices such as arc flash personal protective equipment, electrically insulating rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. Replace any devices or equipment which are damaged due to improper test procedures or handling.

### 3.2.3 Molded-Case Circuit Breakers

Visually inspect circuit breakers. Verify current ratings and adjustable settings incorporated in accordance with the coordination study.

### 3.2.4 Power Circuit Breakers

#### 3.2.4.1 General

Visually inspect the circuit breaker and implement settings in accordance with the coordination study.

#### 3.2.4.2 Current Injection Tests

Test with approved settings installed in accordance with NETA ATS and the Test Plan; document results in the field test reports.

- a. Determine long time pick-up value and delay by primary current injection.
- b. Determine short time pick-up value and delay by primary current injection.
- c. Determine instantaneous pick-up value by primary current injection.
- d. Determine ground-fault pick-up value and delay by primary current injection.
- e. Test trip unit functions by secondary current injection or in accordance with the manufacturer's requirements.

### 3.2.5 Protective Relays

#### 3.2.5.1 General

Visually inspect protective relays. Implement relay settings in accordance with the coordination study.

#### 3.2.5.2 Current Injection Tests

Test with approved settings installed in accordance with NETA ATS and the Test Plan; document results in the field test reports.

- a. Determine long time pick-up value and delay by secondary current injection.
- b. Determine short time pick-up value and delay by secondary current

injection.

- c. Determine instantaneous pick-up value by secondary current injection.
- d. Determine ground fault pick-up value and delay by secondary current injection.

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## SECTION 26 05 71.00 40

## LOW VOLTAGE OVERCURRENT PROTECTIVE DEVICES

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## ASTM INTERNATIONAL (ASTM)

- ASTM A167 (2011) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
- ASTM D877 (2002; R 2007) Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes

## ELECTRONIC INDUSTRIES ALLIANCE (EIA)

- EIA 443 (1979) NARM Standard for Solid State Relays Service

## INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

- IEEE C37.17 (1997) Standard for Trip Devices for AC and General-Purpose DC Low-Voltage Power Circuit Breakers
- IEEE C37.90 (2005) Standard for Relays and Relay Systems Associated With Electric Power Apparatus
- IEEE C57.13 (2008) Standard Requirements for Instrument Transformers
- IEEE C63.2 (2009) Standard for Electromagnetic Noise and Field Strength Instrumentation, 10 Hz to 40 GHz - Specifications
- IEEE C63.4 (2009) American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

## IPC - ASSOCIATION CONNECTING ELECTRONICS INDUSTRIES (IPC)

- IPC D330 (1992) Design Guide Manual

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C12.1	(2008) Electric Meters Code for Electricity Metering
ANSI C78.23	(1995; R 2003) American National Standard for Incandescent Lamps - Miscellaneous Types
NEMA 107	(1987; R 1993) Methods of Measurement of Radio Influence Voltage (RIV) of High-Voltage Apparatus (inactive)
NEMA 250	(2008) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA AB 3	(2006) Molded Case Circuit Breakers and Their Application
NEMA FU 1	(2002; R 2007) Low Voltage Cartridge Fuses
NEMA ICS 1	(2000; R 2005; R 2008) Standard for Industrial Control and Systems: General Requirements
NEMA ICS 2	(2000; R 2005; Errata 2008) Standard for Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 6	(1993; R 2011) Enclosures

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; Errata 2 2012) National Electrical Code
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## UNDERWRITERS LABORATORIES (UL)

UL 489	(2009; Reprint Jun 2011) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 50	(2007; Reprint Apr 2012) Enclosures for Electrical Equipment, Non-environmental Considerations
UL 508	(1999; Reprint Apr 2010) Industrial Control Equipment

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

## SD-02 Shop Drawings

Submit [Connection Diagrams](#) and [Fabrication Drawings](#) for the

following items in accordance with paragraph entitled, "General Requirements," of this section.

Submit Installation drawings for the following items in accordance with the paragraph entitled, "Installation," of this section.

Control Devices  
Protective Devices

#### SD-03 Product Data

Submit manufacturer's equipment and performance data for the following items including use life, system functional flows, safety features, and mechanical automated details.

Motor Control  
Instrument Transformers  
Fuses  
Enclosures  
Circuit Breakers  
Control Devices

Protective Relays  
Indicating Lights

#### SD-07 Certificates

Submit certificates for [Circuit Tests](#) on similar motor-control or submit motor-circuit protector (MCP) units under actual conditions in lieu of factory tests on the actual units provided. Also include [dielectric tests](#).

#### SD-08 Manufacturer's Instructions

Submit manufacturer's instructions for the following items, including special provisions required to install equipment components and system packages. Provide detail on resistance impedances, hazards and safety precautions within the special notices.

Control Devices  
Protective Devices

#### SD-10 Operation and Maintenance Data

Submit Operation and Maintenance Manuals for the following equipment:

Magnetic Motor Controllers  
Combination Motor Controllers  
Circuit Breakers  
Protective Relays

### 1.3 GENERAL REQUIREMENTS

Section [26 00 00.00 20](#) BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

Submit [Connection Diagrams](#) showing the relations and connections of control

devices and protective devices by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another, and internal tubing, wiring, and other devices.

Submit [Fabrication Drawings](#) for control devices and protective devices consisting of fabrication and assembly details to be performed in the factory.

## PART 2 PRODUCTS

### 2.1 MOTOR CONTROL

Conform to [NEMA ICS 1](#), [NEMA ICS 2](#), and [UL 508](#) for motor controllers. Provide controllers that have thermal overload protection in each phase.

#### 2.1.1 Magnetic Motor Controllers

##### 2.1.1.1 Full-Voltage Controllers

Provide full-voltage, full magnetic devices in accordance with [NEMA ICS 1](#), [NEMA ICS 2](#), and [UL 508](#) for magnetic motor controllers for the control and protection of single- and three-phase, 60-hertz, squirrel-cage induction motors.

Provide operating coil assembly that operates satisfactorily between 85 and 110 percent of rated coil voltage. Provide 120 volts, 60 hertz motor control circuits.

Provide controller with two normally open and two normally closed auxiliary contacts rated per [NEMA ICS 1](#) and [NEMA ICS 2](#) in addition to the sealing-in contact for control circuits.

Provide solderless pressure wire terminal connectors for line-and load-connections to controllers.

Include three manual reset thermal overload devices for overcurrent protection, one in each pole of the controller. Provide thermal overload relays of melting-alloy type with continuous current ratings and service-limit current ratings, and with a plus or minus 15 percent adjustment to compensate for ambient operating conditions.

Provide an externally operable manual-reset button to re-establish control power to the holding coil of the electromagnet. After the controller has tripped from overload, ensure that resetting the motor-overload device does not restart the motor.

Provide enclosure in accordance with [NEMA 250](#), Type 12.

#### 2.1.2 Combination Motor Controllers

Following requirements are in addition to the requirements specified for magnetic motor controller:

Provide combination motor controllers for the control and protection of single-and three-phase 60-hertz alternating-current squirrel-cage induction motors with branch-circuit disconnecting and protective devices in accordance with [NEMA ICS 1](#), [NEMA ICS 2](#), and [NEMA ICS 6](#).

For combination motor controllers include magnetic motor controllers

and molded-case circuit breakers or MCP in metal enclosures in accordance with NEMA 250 or motor-control center draw-out assemblies with control-power transformers, selector switches, pushbuttons, and indicating lights as follows:

Provide full-voltage, full-magnetic devices as specified in this section under paragraph entitled, "Remote-Control Station Enclosures." for magnetic motor controllers and enclosures.

Provide thermal-magnetic breakers as specified in paragraph entitled, "Manual Motor Controllers." for molded-case circuit breakers. Manufacturer's standard MCP may be used in lieu of molded-case circuit breakers.

Provide control-power transformers 120-volt ac maximum, selector switches, pushbuttons, and pilot lights as required.

Identify combination motor controllers with identification plates affixed to front cover of the controller.

#### 2.1.2.1 Nonreversing Combination Motor Controllers

Following requirements are in addition to the requirements for magnetic motor controllers:

For nonreversing combination motor controllers for the control and protection of single-speed squirrel-cage induction motors, include a magnetic controller with molded-case circuit breaker or MCP with selector switch or start/stop pushbutton and indicating light in the cover of the enclosure.

Provide rating of three-phase single-speed full-voltage magnetic controllers for nonplugging and nonjogging duty in accordance with NEMA ICS 1 and NEMA ICS 2.

Provide wiring and connections for full-voltage single-speed magnetic controllers in accordance with NEMA ICS 1 and NEMA ICS 2.

#### 2.1.2.2 Reversing Combination Motor Controllers

Following requirements are in addition to the requirements for magnetic motor controllers:

For reversing combination motor controllers for the control and protection of single-speed squirrel-cage induction motors, include two interlocked magnetic controllers with molded-case circuit breaker or MCP, with selector switch or forward/reverse/stop pushbutton and two indicating lights in the cover of the enclosure. Indicate with indicating lights the forward and reverse running connection of the motor controller.

Provide rating of three-phase single-speed full-voltage magnetic controllers for plug-stop, plug-reverse, or jogging duty in accordance with NEMA ICS 1 and NEMA ICS 2.

Provide wiring and connections for full-voltage single-speed magnetic controllers in accordance with NEMA ICS 1 and NEMA ICS 2.

### 2.1.2.3 Two-Speed Combination Motor Controllers

Following requirements are in addition to the requirements for magnetic motor controllers:

For two-speed combination motor controllers for the control and protection of single- and two-winding, two-speed, three-phase, squirrel-cage induction motors, include two magnetic controllers with molded-case circuit breaker or MCP, with selector switch or fast/slow/stop pushbutton and two indicating lights in the cover of the enclosure. Indicate with indicating lights the high- and low-speed running connection of the motor controller.

Provide rating of three-phase, two-speed, full-voltage, magnetic controllers for nonplugging and nonjogging duty for constant- and variable-torque motors in accordance with NEMA ICS 1 and NEMA ICS 2.

Provide rating of three-phase, two-speed, full-voltage, magnetic controllers for nonplugging and nonjogging duty for constant-horsepower motors in accordance with NEMA ICS 1 and NEMA ICS 2.

Provide rating of three-phase, two-speed, full-voltage, magnetic controllers for plug-stop, plug-reverse, or jogging duty for constant-torque, variable-torque, and constant horsepower motors in accordance with NEMA ICS 1 and NEMA ICS 2.

## 2.2 INSTRUMENT TRANSFORMERS

Comply with the interference requirements listed below, measured in accordance with IEEE C63.2, IEEE C63.4, and NEMA 107 for Instrument transformers.

Insulation Class, kV	Basic Insulation Level, kV	Preferred Nominal System Voltage, kV	Test Voltage for Potential Transformers, kV	Test Voltage for Current Transformers, kV	Radio Influence Voltage Level, Microvolts	
					Dry Type	Oil Filled
0.6	10	.....	.....	0.76	250	250

### 2.2.1 Current Transformers

Provide current transformers that conform to IEEE C57.13 for installation in metal-clad switchgear. Use standard 3-A secondary transformer.

Provide window type transformers.

Provide transformers that have single secondary winding.

Provide transformers that are complete with secondary short-circuiting device.

For window-type current transformers, provide indoor dry type construction with secondary current ratings as indicated with specified burden, frequency, and accuracy.



### 2.2.2 Potential Transformers

For potential transformers, conform to [IEEE C57.13](#) for installation in metal-clad switchgear. Use standard 120-volt secondary transformers.

Provide transformers that have single secondary.

Provide burden, frequency, and accuracy as required.

For disconnecting potential transformers with integral fuse mountings and current-limiting fuses, provide indoor dry type two-winding construction with primary and secondary voltage ratings as required.

## 2.3 ENCLOSURES

### 2.3.1 Equipment Enclosures

Provide enclosures for equipment in accordance with [NEMA 250](#).

Contain equipment installed in industrial locations in a NEMA Type 12 industrial use, sheet-steel enclosure, constructed to prevent the entrance of dust, lint, fibers, flyings, oil, and coolant seepage.

### 2.3.2 Remote-Control Station Enclosures

Provide remote-control station enclosures for pushbuttons, selector switches, and indicating lights in accordance with the appropriate articles of [NEMA ICS 6](#) and [NEMA 250](#).

Contain remote-control stations installed in dry noncombustible dust laden atmospheres in NEMA Type 12 dust tight, cast-iron enclosures with gaskets or their equivalent to prevent the entrance of dust.

Contain remote-control stations installed in industrial locations in NEMA Type 12 industrial-use, sheet-steel enclosures, constructed to prevent the entrance of dust, lint, fibers, flyings, oil, and coolant seepage.

Install remote-control stations with the centerline [66 inches](#) above the finished floor.

## 2.4 CIRCUIT BREAKERS

Provide circuit breakers that conform to [UL 489](#), and [NEMA AB 3](#).

### 2.4.1 Molded-Case Circuit Breakers

Provide molded case, manually operated, trip-free, circuit breakers, with inverse-time thermal-overload protection and instantaneous magnetic short-circuit protection as required. Completely enclose circuit breakers in a molded case, with the calibrated sensing element factory-sealed to prevent tampering.

Locate thermal-magnetic tripping elements in each pole of the circuit breaker, and provide inverse-time-delay thermal overload protection and instantaneous magnetic short-circuit protection. Provide instantaneous magnetic tripping element, that is adjustable and accessible from the front of the breaker on frame sizes larger than 100 amperes.

Size breaker as required for the continuous current rating of the circuit. Provide breaker class as required.

Provide sufficient interrupting capacity of the panel and lighting branch circuit breakers, to successfully interrupt the maximum short-circuit current imposed on the circuit at the breaker terminals. Provide circuit breaker interrupting capacities with a minimum of 10,000 amperes and that conform to [NEMA AB 3](#).

Provide the common-trip type multipole circuit breakers having a single operating handle and a two-position on/off indication. Provide circuit breakers with temperature compensation for operation in an ambient temperature of [104 degrees F](#). Provide circuit breakers that have root mean square (rms) symmetrical interrupting ratings sufficient to protect the circuit being supplied. Interrupting ratings may have selective type tripping (time delay, magnetic, thermal, or ground fault).

Provide phenolic composition breaker body capable of having such accessories as handle-extension, handle-locking, and padlocking devices attached where required.

Provide circuit breakers used for meter circuit disconnects that meet the applicable requirements of [NFPA 70](#) and that are of the motor-circuit protector type.

For circuit breakers used for service disconnection, provide an enclosed circuit-breaker type with external handle for manual operation. Provide sheet metal enclosures with a hinged cover suitable for surface mounting.

#### 2.4.2 Enclosed Molded-Case Circuit Breakers

For enclosed circuit breakers, provide thermal-magnetic molded-case circuit breakers in surface-mounted, nonventilated enclosures conforming to the appropriate articles of [NEMA 250](#) and [UL 489](#).

Provide enclosed circuit breakers in nonhazardous locations as follows:

Contain circuit breakers installed in industrial locations in NEMA Type 12, industrial-use sheet steel enclosures, constructed to prevent the entrance of dust, lint, fibers and flyings, and oil and coolant seepage.

Fabricate steel enclosures from corrosion-resistant steel sheet, conforming to [ASTM A167](#), 300 series corrosion-resistant steel, with box dimensions and thickness of sheet steel in accordance with [UL 50](#).

#### 2.5 FUSES

Provide a complete set of fuses for all switches and switchgear. Rate fuses that have a voltage rating of not less than the circuit voltage.

Make no change in continuous-current rating, interrupting rating, and clearing or melting time of fuses unless written permission has first been secured.

Provide nonrenewable cartridge type fuses for ratings 30 amperes, 125 volts or less. Provide renewable cartridge type fuses for ratings above 30 amperes 600 volts or less with time-delay dual elements, except where otherwise indicated. Conform to [NEMA FU 1](#) for fuses.

Install special fuses such as extra-high interrupting-capacity fuses, fuses for welding machines, and capacitor fuses where required. Plug fuses are not permitted.

Label fuses showing UL class, interrupting rating, and time-delay characteristics, when applicable. Additionally, clearly list fuse information on equipment drawings.

Provide porcelain fuse holders when field-mounted in a cabinet or box. Do not use fuse holders made of such materials as ebony asbestos, Bakelite, or pressed fiber for field installation.

## 2.6 CONTROL DEVICES

### 2.6.1 Magnetic Contactors

Provide magnetic contactors in accordance with NEMA ICS 1 and NEMA ICS 2 as required for the control of low-voltage, 60-hertz, tungsten-lamp loads, fluorescent-lamp loads, resistance-heating loads, and the primary windings of low-voltage transformers.

Provide core-and-coil assembly that operates satisfactorily with coil voltage between 85 and 110 percent of its voltage rating.

Provide contactor that is designed with a normally open holding circuit auxiliary contact for control circuits, with a rating in accordance with NEMA ICS 1 and NEMA ICS 2.

Furnish solderless pressure wire terminal connectors, or make available for line-and-load connections to contactors in accordance with NEMA ICS 1 and NEMA ICS 2.

Provide magnetic contactors with a rating in accordance with NEMA ICS 1 and NEMA ICS 2.

### 2.6.2 Control-Circuit Transformers

Provide control-circuit transformers within the enclosure of magnetic contactors and motor controllers when the line voltage is in excess of 120 volts. Provide encapsulated dry type, single-phase, 60-hertz transformer, with a 120-volt (or 24-volt) isolated secondary winding.

Do not provide a transformer with a rated primary voltage less than the rated voltage of the controller, or a rated secondary current less than the continuous-duty current of the control circuit.

Provide voltage regulation of the transformer such that, with rated primary voltage and frequency, the secondary voltage is not less than 95 percent nor more than 105 percent of rated secondary voltage.

Provide source of supply for control-circuit transformers at the load side of the main disconnecting device. Protect secondary winding of the transformer and control-circuit wiring against overloads and short circuits, with fuses selected in accordance with NEMA ICS 6. Ground secondary winding of the control-circuit transformer in accordance with NEMA ICS 6.

### 2.6.3 Magnetic Control Relays

Provide magnetic control relays for energizing and de-energizing the coils of magnetic contactors or other magnetically operated devices, in response to variations in the conditions of electric control devices in accordance with NEMA ICS 1, and NEMA ICS 2.

Provide core-and-coil assembly that operates satisfactorily with coil voltages between 85 and 110 percent of their voltage rating.

Provide relays that are designed to accommodate normally open and normally closed contacts.

Provide 120-volt, 60-hertz, Class AIB magnetic control relays with a continuous contact rating of 10 amperes, and with current-making and -breaking ability in accordance with NEMA ICS 1 and NEMA ICS 2, two normally open and two normally closed.

### 2.6.4 Pushbuttons and Switches

#### 2.6.4.1 Pushbuttons

For pushbuttons for low-voltage ac full-voltage magnetic controllers, provide heavy-duty oiltight NEMA 250, Type 4 or as indicated, momentary-contact devices rated 600 volts, with pilot light, and with the number of buttons and the marking of identification plates as shown. Furnish pushbutton color code in accordance with NEMA ICS 6.

Provide pushbuttons that are designed with normally open, circuit-closing contacts; normally closed circuit-opening contacts; and two-circuit normally open and normally closed circuit-closing and -opening contacts. Provide pushbutton-contact ratings in accordance with NEMA ICS 1 and NEMA ICS 2 with contact designation A600.

Identify pushbuttons in remote control stations with identification plates affixed to front cover in a prominent location. Carry the identification of the system being controlled on the identification plate.

#### 2.6.4.2 Selector Switches

Provide heavy-duty oiltight maintained-contact selector switches for low-voltage control circuits, with the number of positions and the marking of identification plates in accordance with NEMA ICS 1 and NEMA ICS 2.

Identify selector switches in remote control stations with engraved identification plates affixed to front cover in a prominent location. Carry the identification of the system being controlled on the identification plate.

#### 2.6.4.3 Miscellaneous Switches

Provide float, limit, door, pressure, proximity, and other types of switches in accordance with IPC D330 and of the types and classes indicated.

## 2.7 PROTECTIVE RELAYS

### 2.7.1 Overcurrent Relays

Conform to IEEE C37.90 for overcurrent relays.

For protection against phase and ground faults, provide single-phase nondirectional removable induction type overcurrent relays with built-in testing facilities designed for operation on the dc or ac control circuit indicated.

Provide ground-fault overcurrent relays with short-time inverse time characteristics with adjustable current tap range as required.

Provide phase-fault overcurrent relays with varied inverse-time characteristics with adjustable current tap range as required, and indicating instantaneous-trip attachments with adjustable current range as required.

Semiflush-mount case with matching cover to the hinged instrument panel.

Provide solid-state static-type trips for low-voltage power circuit breakers in accordance with [EIA 443](#) and [IEEE C37.17](#).

Provide a trip unit that employs a combination of discreet components and integrated circuits to provide the time-current protection functions required in a modern selectively coordinated distribution system.

Provide complete system selective coordination by utilizing a combination of the following time-current curve-shaping adjustments: ampere setting; long-time delay; short-time pickup; short-time delay; instantaneous pickup; and ground fault.

Provide switchable or easily defeatable instantaneous and ground fault trips.

Make all adjustments using non-removable, discrete step, highly reliable switching plugs for precise settings. Provide a sealable, transparent cover over the adjustments to prevent tampering.

Furnish trip devices with three visual indicators to denote the automatic tripping mode of the breaker including: overload; short circuit; and ground fault.

Wire trip unit to appropriate terminals whereby an optional remote automatic trip accessory can be utilized to provide the same indication.

Make available for use a series of optional automatic trip relays for use with the trip unit to provide remote alarm and lockout circuits.

Provide all trip units with test jacks for in-service functional testing of the long-time instantaneous and ground fault circuits using a small hand-held test kit.

#### 2.7.2 Directional Overcurrent Relays

Provide directional overcurrent relays in accordance with [IEEE C37.90](#).

For directional overcurrent relays for protection against reverse-power faults, provide single-phase induction type with adjustable time-delay and instantaneous trip attachments. Provide removable type relays with inverse-time directional and overcurrent units with built-in testing facilities.

Semi-flush mount case with matching cover to the hinged instrument panel.

### 2.7.3 Undervoltage Relays

For undervoltage relays conform to [IEEE C37.90](#).

Provide three-phase induction type undervoltage relays, including inverse timing with adjustable high- and low-voltage contacts and calibrated scale for protection against loss of voltage, undervoltage, and overvoltage. Equip relays with indicating contactor and voltage switches to provide electrically separate contact circuits. Provide relays that are removable with built-in testing facilities and that are suitable for operation on 120-volt ac circuits, with contacts that are suitable for operation on dc or ac control circuits.

Semi-flush mount case with matching cover to the hinged instrument panel.

## 2.8 FACTORY TESTING

Perform factory tests on control and low voltage protective devices in accordance with the manufacturer's recommendations.

Conduct short-circuit tests in accordance with Section 2 of [NEMA ICS 1](#).

## 2.9 INDICATING LIGHTS

### 2.9.1 General-Purpose Type

For indicating lights, provide oiltight instrument devices with threaded base and collar for flush-mounting, translucent convex lens, candelabra screw-base lampholder, and 120-volt, 6-watt, Type S-6 incandescent lamp in accordance with [ANSI C78.23](#). Provide indicating lights color coded in accordance with [NEMA ICS 6](#).

Provide indicating lights in remote-control stations when pushbuttons and selector switches are out of sight of the controller.

## 2.10 FINISH

Protect metallic materials against corrosion. Provide equipment with the standard finish by the manufacturer when used for most indoor installations. For harsh indoor environments (any area subjected to chemical and/or abrasive action), and all outdoor installations, refer to Section [09 90 00.00 98 PAINTING AND COATINGS](#).

## PART 3 EXECUTION

### 3.1 INSTALLATION

Install [Control devices](#) and [protective devices](#) that are not factory installed in equipment, in accordance with the manufacturer's recommendations and field adjusted and operation tested. Conform to [NFPA 70](#), [NEMA ICS 1](#) and [NEMA ICS 2](#) requirements for installation of control and protective devices.

### 3.2 FIELD TESTING

Demonstrate to operate as indicated control and protective devices not factory installed in equipment.

Ratio and verify tap settings of instrumentation, potential, and current transformers.

Perform [dielectric tests](#) on insulating oil in oil circuit breakers before the breakers are energized. Test oil in accordance with [ASTM D877](#), and provide breakdown voltage that is not less than 25,000 volts. Provide manufacturer certification that the oil contains no PCB's, and affix a label to that effect on each breaker tank and on each oil drum containing the insulating oil.

Field adjust reduced-voltage starting devices to obtain optimum operating conditions. Provide test meters and instrument transformers that conform to [ANSI C12.1](#) and [IEEE C57.13](#).

Do not energize control and protective devices until recorded test data has been approved. Provide final test reports with a cover letter/sheet clearly marked with the System name, Date, and the words "Final Test Reports - Forward to the Systems Engineer/Condition Monitoring Office/Predictive Testing Group for inclusion in the Maintenance Database."

-- End of Section --

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SECTION 26 08 00

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## SECTION 26 08 00

## APPARATUS INSPECTION AND TESTING

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

## NETA ATS

(2009) Standard for Acceptance Testing  
Specifications for Electrical Power  
Equipment and Systems

## 1.2 RELATED REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to this section with additions and modifications specified herein.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

## SD-06 Test Reports

Acceptance tests and inspections; G

## SD-07 Certificates

Qualifications of organization, and lead engineering technician; G

Acceptance test and inspections procedure; G

## 1.4 QUALITY ASSURANCE

## 1.4.1 Qualifications

Contractor shall engage the services of a qualified testing organization to provide inspection, testing, calibration, and adjustment of the electrical distribution system and generation equipment listed in paragraph entitled "Acceptance Tests and Inspections" herein. Organization shall be independent of the supplier, manufacturer, and installer of the equipment. The organization shall be a first tier subcontractor. No work required by this section of the specification shall be performed by a second tier subcontractor.

- a. Submit name and qualifications of organization. Organization shall have been regularly engaged in the testing of electrical materials, devices, installations, and systems for a minimum of 5 years. The

organization shall have a calibration program, and test instruments used shall be calibrated in accordance with NETA ATS.

- b. Submit name and qualifications of the lead engineering technician performing the required testing services. Include a list of three comparable jobs performed by the technician with specific names and telephone numbers for reference. Testing, inspection, calibration, and adjustments shall be performed by an engineering technician, certified by NETA or the National Institute for Certification in Engineering Technologies (NICET) with a minimum of 5 years' experience inspecting, testing, and calibrating electrical distribution and generation equipment, systems, and devices.

#### 1.4.2 Acceptance Tests and Inspections Reports

Submit certified copies of inspection reports and test reports. Reports shall include certification of compliance with specified requirements, identify deficiencies, and recommend corrective action when appropriate. Type and neatly bind test reports to form a part of the final record. Submit test reports documenting the results of each test not more than 10 days after test is completed.

#### 1.4.3 Acceptance Test and Inspections Procedure

Submit test procedure reports for each item of equipment to be field tested at least 45 days prior to planned testing date. Do not perform testing until after test procedure has been approved.

### PART 2 PRODUCTS

Not used.

### PART 3 EXECUTION

#### 3.1 ACCEPTANCE TESTS AND INSPECTIONS

Testing organization shall perform acceptance tests and inspections. Test methods, procedures, and test values shall be performed and evaluated in accordance with NETA ATS, the manufacturer's recommendations, and paragraph entitled "Field Quality Control" of each applicable specification section. Tests identified as optional in NETA ATS are not required unless otherwise specified. Equipment shall be placed in service only after completion of required tests and evaluation of the test results have been completed. Contractor shall supply to the testing organization complete sets of shop drawings, settings of adjustable devices, and other information necessary for an accurate test and inspection of the system prior to the performance of any final testing. Contracting Officer shall be notified at least 14 days in advance of when tests will be conducted by the testing organization. Perform acceptance tests and inspections on applicable equipment and systems specified in the following sections:

- a. Section 26 23 00.00 40 SWITCHBOARDS AND SWITCH GEAR.

#### 3.2 SYSTEM ACCEPTANCE

Final acceptance of the system is contingent upon satisfactory completion

of acceptance tests and inspections.

### 3.3 PLACING EQUIPMENT IN SERVICE

A representative of the approved testing organization shall be present when equipment tested by the organization is initially energized and placed in service.

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## SECTION 26 23 00.00 40

## SWITCHBOARDS AND SWITCHGEAR

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

## ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2012) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A653/A653M	(2011) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B187/B187M	(2011) Standard Specification for Copper, Bus Bar, Rod and Shapes and General Purpose Rod, Bar and Shapes
ASTM D1535	(2012a) Specifying Color by the Munsell System
ASTM D709	(2001; R 2007) Laminated Thermosetting Materials

## INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2012; Errata 2012; INT 1 2012; INT 2 2012) National Electrical Safety Code
IEEE C57.12.01	(2005) General Requirements for Dry-Type Distribution and Power Transformers Including Those with Solid-Cast and/or Resin-Encapsulated Windings
IEEE C57.12.28	(2005; INT 3 2011) Standard for Pad-Mounted Equipment - Enclosure Integrity
IEEE Stds Dictionary	(2009) IEEE Standards Dictionary: Glossary of Terms & Definitions

## INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2009) Standard for Acceptance Testing
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Specifications for Electrical Power  
Equipment and Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI/NEMA PB 2.1	(2007) General Instructions for Proper Handling, Installation, Operation and Maintenance of Deadfront Distribution Switchboards Rated 600 V or Less
NEMA ICS 6	(1993; R 2011) Enclosures
NEMA PB 2	(2011) Deadfront Distribution Switchboards

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; Errata 2 2012) National Electrical Code
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UNDERWRITERS LABORATORIES (UL)

UL 467	(2007) Grounding and Bonding Equipment
UL 489	(2009; Reprint Jun 2011) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 891	(2005; Reprint Oct 2012) Switchboards

1.2 RELATED REQUIREMENTS

Section 26 08 00 APPARATUS INSPECTION AND TESTING applies to this section, with the additions and modifications specified herein.

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, use as defined in IEEE Stds Dictionary.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Switchboard Drawings; G

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Indicate within the drawings adequate clearance for operation, maintenance, and replacement of operating

equipment devices. Include submittals for the nameplate data, size, and capacity. Also include submittals for applicable federal, military, industry, and technical society publication references.

#### SD-03 Product Data

Switchboard; G

#### SD-06 Test Reports

Switchboard Design Tests; G

Switchboard Production Tests; G

Acceptance Checks And Tests; G

#### SD-11 Closeout Submittals

Assembled Operation and Maintenance Manuals

Equipment Test Schedule

Request for Settings

### 1.5 QUALITY ASSURANCE

#### 1.5.1 Switchboard Product Data

Each submittal shall include manufacturer's information for each component, device and accessory provided with the switchboard including:

- a. Circuit breaker type, interrupting rating, and trip devices, including available settings
- b. Manufacturer's instruction manuals and published time-current curves (on full size logarithmic paper) of the main secondary breaker and largest secondary feeder device.

#### 1.5.2 Switchboard Drawings

Drawings shall include, but are not limited to the following:

- a. One-line diagram including breakers, fuses, current transformers, and meters
- b. Outline drawings including front elevation, section views, footprint, and overall dimensions
- c. Bus configuration including dimensions and ampere ratings of bus bars
- d. Markings and NEMA nameplate data, including fuse information (manufacturer's name, catalog number, and ratings)
- e. Circuit breaker type, interrupting rating, and trip devices, including available settings
- f. Three-line diagrams and elementary diagrams and wiring diagrams with terminals identified, and indicating prewired interconnections between



items of equipment and the interconnection between the items.

- g. Manufacturer's instruction manuals and published time-current curves (on full size logarithmic paper) of the main secondary breaker and largest secondary feeder device. These shall be used by the designer of record to provide breaker settings that will ensure protection and coordination are achieved.

#### 1.5.3 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

#### 1.5.4 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

##### 1.5.4.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

##### 1.5.4.2 Material and Equipment Manufacturing Date

Do not use products manufactured more than 3 years prior to date of delivery to site, unless specified otherwise.

#### 1.6 MAINTENANCE

##### 1.6.1 Assembled Operation and Maintenance Manuals

Assemble and bind manuals securely in durable, hard covered, water resistant binders. Assemble and index the manuals in the following order with a table of contents. The contents of the assembled operation and maintenance manuals shall be as follows:

- a. Manufacturer's O&M information.
- b. Catalog data required by the paragraph entitled, "SD-03, Product Data".
- c. Drawings required by the paragraph entitled, "SD-02, Shop Drawings".

- d. Prices for spare parts and supply list.
- e. Information on metering
- f. Design test reports
- g. Production test reports

#### 1.6.2 Spare Parts

Furnish spare parts as specified below. All spare parts shall be of the same material and workmanship, shall meet the same requirements, and shall be interchangeable with the corresponding original parts furnished.

- a. 2 - Fuses of each type and size.

#### 1.7 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

### PART 2 PRODUCTS

#### 2.1 PRODUCT COORDINATION

Products and materials not considered to be switchboards and related accessories are specified in Section 26 05 00.00 40 COMMON WORK RESULTS FOR ELECTRICAL.

#### 2.2 SWITCHBOARD

NEMA PB 2 and UL 891.

##### 2.2.1 Ratings

The voltage rating of the switchboard shall be 480Y/277 volts AC, 4-wire 3 phase. The continuous current rating of the main bus shall be as indicated. The short-circuit current rating shall be as indicated. The switchboard shall be UL listed and labeled for its intended use.

##### 2.2.2 Construction

The switchboards shall be dead-front switchboards conforming to NEMA PB 2 and labeled under UL 891. The switchboards shall be completely enclosed self-supporting metal structures with the required number of vertical panel sections, buses, molded-case circuit breakers, as shown on the drawings. Switchboards shall be fully rated for a short-circuit current of 65,000 symmetrical amperes RMS AC.

##### 2.2.2.1 Enclosure

The switchboard enclosure shall be a NEMA ICS 6 Type 12. Enclosure shall be bolted together with removable bolt-on side and hinged rear covers. Front doors shall be provided with padlockable vault handles with a three point catch. Bases, frames and channels of enclosure shall be corrosion resistant and shall be fabricated of galvanized steel. Base shall include

any part of enclosure that is within 3 inches of concrete pad. Galvanized steel shall be ASTM A123/A123M, ASTM A653/A653M G90 coating, and ASTM A153/A153M, as applicable. Galvanize after fabrication where practicable. Paint enclosure, including bases, ASTM D1535 light gray No. 61 or No. 49. Paint coating system shall comply with IEEE C57.12.28 for galvanized steel.

#### 2.2.2.2 Bus Bars

All buses shall be of copper and all bolted splices and connections between buses and for extensions or taps for equipment shall be tin or silver-plated throughout. Copper bars and shapes for bus conductors shall conform to the applicable requirements of ASTM B187/B187M. All splices for field assembly shall be bolted with at least two bolts and shall employ the use of "Belleville" washers in the connection. Horizontal and vertical power buses have minimum current ratings as shown on the drawings. The buses shall be insulated for not less than 600 volts. Shop splices and tap connections shall be brazed, pressure-welded or bolted. All splices for field assembly shall be bolted. Mount the buses on insulating supports of wet process porcelain, glass polyester, or suitable molded material, and brace to withstand not less than 65,000 symmetrical amperes ac. A copper ground bus, rated not less than 300 amps, extending the entire length of the assembled structure, shall be mounted near the bottom of enclosure. A full clamp-type solderless copper or copper alloy lug for No. 2/0 AWG stranded copper cable shall be provided at each end of the bus for connection to the station grounding system.

#### 2.2.2.3 Main Section

The main section shall consist of molded-case circuit breaker.

#### 2.2.2.4 Distribution Sections

The distribution sections shall consist of molded-case circuit breakers as indicated.

#### 2.2.3 Protective Device

Provide main and branch protective devices as indicated.

##### 2.2.3.1 Molded-Case Circuit Breaker

UL 489. UL listed and labeled, 100 percent rated, stationary manually operated, low voltage molded-case circuit breaker, with a short-circuit current rating as indicated at 480 volts. Breaker frame size is to be as indicated. Series rated circuit breakers are unacceptable.

Equip each switchboard with molded-case circuit breakers with trip ratings and terminal connectors for attachment of outgoing power cables as shown on the drawings. The circuit breakers shall be operable and removable from the front. Where shown on the drawings, enclose circuit breakers in individual compartments.

#### 2.2.4 Electronic Trip Units

Equip main and distribution breakers with a solid-state tripping system consisting of three current sensors and a microprocessor-based trip unit that will provide true rms sensing adjustable time-current circuit protection. The ampere rating of the current sensors are to be as

indicated. The trip unit ampere rating shall be as indicated.

- a. Breakers shall have long delay pick-up and time settings, and LED indication of cause of circuit breaker trip.
- b. Main breakers shall have short delay pick-up and time settings, instantaneous settings and ground fault settings as indicated.
- c. Distribution breakers shall have short delay pick-up and time settings and instantaneous settings as indicated.

#### 2.2.5 Heaters

Provide 120-volt heaters in each switchboard section. Heaters shall be of sufficient capacity to control moisture condensation in the section, shall be 250 watts minimum, and shall be controlled by a thermostat located in the section. Thermostat shall be industrial type, high limit, to maintain sections within the range of 60 to 90 degrees F. Supply voltage for the heaters shall be obtained from a control power transformer within the switchboard. If heater voltage is different than switchboard voltage, provide transformer rated to carry 125 percent of heater full load rating. Transformer shall have 220 degrees C insulation system with a temperature rise not exceeding 115 degrees C and shall conform to IEEE C57.12.01. Energize electric heaters in switchboard assemblies while the equipment is in storage or in place prior to being placed in service. Provide method for easy connection of heater to external power source. Provide temporary, reliable external power source if commercial power at rated voltage is not available on site.

#### 2.2.6 Terminal Boards

Provide with engraved plastic terminal strips and screw type terminals for external wiring between components and for internal wiring between removable assemblies. Terminal boards associated with current transformers shall be short-circuiting type. Terminate conductors for current transformers with ring-tongue lugs. Terminal board identification shall be identical in similar units. External wiring shall be color coded consistently for similar terminal boards.

#### 2.2.7 Wire Marking

Mark control and metering conductors at each end. Provide factory-installed, white, plastic tubing, heat stamped with black block type letters on factory-installed wiring. On field-installed wiring, provide white, preprinted, polyvinyl chloride (PVC) sleeves, heat stamped with black block type letters. Each sleeve shall contain a single letter or number, shall be elliptically shaped to securely grip the wire, and shall be keyed in such a manner to ensure alignment with adjacent sleeves. Provide specific wire markings using the appropriate combination of individual sleeves. Each wire marker shall indicate the device or equipment, including specific terminal number to which the remote end of the wire is attached.

#### 2.3 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable. This nameplate and method of attachment may be the

manufacturer's standard if it contains the required information.

## 2.4 FIELD FABRICATED NAMEPLATES

**ASTM D709.** Provide laminated plastic nameplates for each switchboard, equipment enclosure, relay, switch, and device; as specified in this section or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, **0.125 inch** thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be **one by 2.5 inches**. Lettering shall be a minimum of **0.25 inch** high normal block style.

## 2.5 SOURCE QUALITY CONTROL

### 2.5.1 Equipment Test Schedule

The Government reserves the right to witness tests. Provide equipment test schedules for tests to be performed at the manufacturer's test facility. Submit required test schedule and location, and notify the Contracting Officer 30 calendar days before scheduled test date. Notify Contracting Officer 15 calendar days in advance of changes to scheduled date.

#### a. Test Instrument Calibration

- (1) The manufacturer shall have a calibration program which assures that all applicable test instruments are maintained within rated accuracy.
- (2) The accuracy shall be directly traceable to the National Institute of Standards and Technology.
- (3) Instrument calibration frequency schedule shall not exceed 12 months for both test floor instruments and leased specialty equipment.
- (4) Dated calibration labels shall be visible on all test equipment.
- (5) Calibrating standard shall be of higher accuracy than that of the instrument tested.
- (6) Keep up-to-date records that indicate dates and test results of instruments calibrated or tested. For instruments calibrated by the manufacturer on a routine basis, in lieu of third party calibration, include the following:
  - (a) Maintain up-to-date instrument calibration instructions and procedures for each test instrument.
  - (b) Identify the third party/laboratory calibrated instrument to verify that calibrating standard is met.

### 2.5.2 Switchboard Design Tests

**NEMA PB 2** and **UL 891**.

#### 2.5.2.1 Design Tests

Furnish documentation showing the results of design tests on a product of the same series and rating as that provided by this specification.

- a. Short-circuit current test
- b. Enclosure tests
- c. Dielectric test

#### 2.5.3 Switchboard Production Tests

NEMA PB 2 and UL 891. Furnish reports which include results of production tests performed on the actual equipment for this project. These tests include:

- a. 60-hertz dielectric tests
- b. Mechanical operation tests
- c. Electrical operation and control wiring tests
- d. Ground fault sensing equipment test

#### 2.6 COORDINATED POWER SYSTEM PROTECTION

Provide a power system study as specified in Section 26 05 63.00 98 COORDINATED POWER SYSTEM PROTECTION AND ARC FLASH ANALYSIS.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

Electrical installations shall conform to IEEE C2, NFPA 70, and to the requirements specified herein.

#### 3.2 GROUNDING

NFPA 70 and IEEE C2, except that grounds and grounding systems shall have a resistance to solid earth ground not exceeding 5 ohms.

##### 3.2.1 Equipment Grounding

Provide bare copper cable not smaller than No. 4/0 AWG connecting to the facility structure. When work in addition to that indicated or specified is directed to obtain the specified ground resistance, the provision of the contract covering "Changes" shall apply.

##### 3.2.2 Connections

Make joints in grounding conductors by exothermic weld or compression connector. Exothermic welds and compression connectors shall be installed as specified in per manufacturer's requirements and NFPA 70.

##### 3.2.3 Grounding and Bonding Equipment

UL 467, except as indicated or specified otherwise.

### 3.3 INSTALLATION OF EQUIPMENT AND ASSEMBLIES

Install and connect equipment furnished under this section as indicated on project drawings, the approved shop drawings, and as specified herein.

#### 3.3.1 Switchboard

ANSI/NEMA PB 2.1.

#### 3.3.2 Field Applied Painting

Where field painting of enclosures is required to correct damage to the manufacturer's factory applied coatings, provide manufacturer's recommended coatings and apply in accordance with manufacturer's instructions.

#### 3.3.3 Galvanizing Repair

Repair damage to galvanized coatings using Section 09 97 13.00 98, STEEL COATINGS.

#### 3.3.4 Field Fabricated Nameplate Mounting

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

### 3.4 FOUNDATION FOR EQUIPMENT AND ASSEMBLIES

#### 3.4.1 Interior Location

Mount switchboard on concrete slab. Unless otherwise indicated, the slab shall be at least 4 inches thick. The top of the concrete slab shall be approximately 4 inches above finished floor. Edges above floor shall have 1/2 inch chamfer. The slab shall be of adequate size to project at least 8 inches beyond the equipment. Provide conduit turnups and cable entrance space required by the equipment to be mounted. Seal voids around conduit openings in slab with water- and oil-resistant caulking or sealant. Cut off and bush conduits 3 inches above slab surface.

### 3.5 FIELD QUALITY CONTROL

Contractor shall submit request for settings of breakers to the Contracting Officer after approval of switchboard and at least 30 days in advance of their requirement.

#### 3.5.1 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

##### 3.5.1.1 Switchboard Assemblies

###### a. Visual and Mechanical Inspection

- (1) Compare equipment nameplate data with specifications and approved shop drawings.

- (2) Inspect physical, electrical, and mechanical condition.
- (3) Confirm correct application of manufacturer's recommended lubricants.
- (4) Verify appropriate anchorage, required area clearances, and correct alignment.
- (5) Inspect all doors, panels, and sections for paint, dents, scratches, fit, and missing hardware.
- (6) Verify that fuse and circuit breaker sizes and types correspond to approved shop drawings.
- (7) Verify that current transformer ratios correspond to approved shop drawings.
- (8) Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.
- (9) Confirm correct operation and sequencing of electrical and mechanical interlock systems.
- (10) Clean switchboard.
- (11) Inspect insulators for evidence of physical damage or contaminated surfaces.
- (12) Verify correct barrier installation and operation.
- (13) Exercise all active components.
- (14) Inspect all mechanical indicating devices for correct operation.
- (15) Verify that vents are clear.
- (16) Test operation, alignment, and penetration of instrument transformer withdrawal disconnects.
- (17) Inspect control power transformers.

b. Electrical Tests

- (1) Perform insulation-resistance tests on each bus section.
- (2) Perform overpotential tests.
- (3) Perform insulation-resistance test on control wiring; Do not perform this test on wiring connected to solid-state components.
- (4) Perform control wiring performance test.
- (5) Perform primary current injection tests on the entire current circuit in each section of assembly.
- (7) Verify operation of switchboard heaters.



## 3.5.1.2 Circuit Breakers - Low Voltage - Power

## a. Visual and Mechanical Inspection

- (1) Compare nameplate data with specifications and approved shop drawings.
- (2) Inspect physical and mechanical condition.
- (3) Confirm correct application of manufacturer's recommended lubricants.
- (4) Inspect anchorage, alignment, and grounding. Inspect arc chutes. Inspect moving and stationary contacts for condition, wear, and alignment.
- (5) Verify that all maintenance devices are available for servicing and operating the breaker.
- (6) Verify that primary and secondary contact wipe and other dimensions vital to satisfactory operation of the breaker are correct.
- (7) Perform all mechanical operator and contact alignment tests on both the breaker and its operating mechanism.
- (8) Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.
- (9) Verify cell fit and element alignment.

## b. Electrical Tests

- (1) Perform contact-resistance tests on each breaker.
- (2). Perform insulation-resistance tests.
- (3) Adjust Breaker(s) for final settings in accordance with Government provided settings.
- (4).. Determine long-time minimum pickup current by primary current injection.
- (5) Determine long-time delay by primary current injection.
- (6) Determine short-time pickup and delay by primary current injection.
- (7) Determine ground-fault pickup and delay by primary current injection.
- (8) Determine instantaneous pickup value by primary current injection.
- (9) Activate auxiliary protective devices, such as ground-fault or undervoltage relays, to ensure operation of shunt trip devices; Check the operation of electrically-operated breakers in their cubicle.

- (10) Verify correct operation of any auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, and antipump function.

#### 3.5.1.3 Circuit Breakers

##### Low Voltage Molded Case with Solid State Trips

##### a. Visual and Mechanical Inspection

- (1) Compare nameplate data with specifications and approved shop drawings.
- (2) Inspect circuit breaker for correct mounting.
- (3) Operate circuit breaker to ensure smooth operation.
- (4) Inspect case for cracks or other defects.
- (5) Inspect all bolted electrical connections for high resistance using low resistance ohmmeter, verifying tightness of accessible bolted connections and/or cable connections by calibrated torque-wrench method, or performing thermographic survey.
- (6) Inspect mechanism contacts and arc chutes in unsealed units.

##### b. Electrical Tests

- (1) Perform contact-resistance tests.
- (2) Perform insulation-resistance tests.
- (3) Perform Breaker adjustments for final settings in accordance with Government provided settings.
- (4) Perform long-time delay time-current characteristic tests.
- (5) Determine short-time pickup and delay by primary current injection.
- (6) Determine ground-fault pickup and time delay by primary current injection.
- (7) Determine instantaneous pickup current by primary injection.
- (8) Verify correct operation of any auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, and anti-pump function.

#### 3.5.1.4 Current Transformers

##### a. Visual and Mechanical Inspection

- (1) Compare equipment nameplate data with specifications and approved shop drawings.
- (2) Inspect physical and mechanical condition.

- (3) Verify correct connection.
- (4) Verify that adequate clearances exist between primary and secondary circuit.
- (5) Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.
- (6) Verify that all required grounding and shorting connections provide good contact.

b. Electrical Tests

- (1) Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.
- (2) Perform insulation-resistance tests.
- (3) Perform polarity tests.
- (4) Perform ratio-verification tests.

3.5.1.5 Grounding System

a. Visual and Mechanical Inspection

- (1) Inspect ground system for compliance with contract plans and specifications.

3.5.2 Follow-Up Verification

Upon completion of acceptance checks, settings, and tests, the Contractor shall show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. Circuit breakers shall be tripped by operation of each protective device. Test shall require each item to perform its function not less than three times. As an exception to requirements stated elsewhere in the contract, the Contracting Officer shall be given 5 working days advance notice of the dates and times for checks, settings, and tests.

-- End of Section --

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## SECTION 26 51 00.00 40

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## SECTION 26 51 00.00 40

## INTERIOR LIGHTING

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

## ASTM INTERNATIONAL (ASTM)

ASTM A580/A580M (2012a) Standard Specification for  
Stainless Steel Wire

ASTM A641/A641M (2009a) Standard Specification for  
Zinc-Coated (Galvanized) Carbon Steel Wire

## CALIFORNIA ENERGY COMMISSION (CEC)

CEC Title 24 (1978; R 2005) California's Energy  
Efficiency Standards for Residential and  
Nonresidential Buildings

## ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IES)

IES HB-10 (2011) IES Lighting Handbook

## INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2 (2012; Errata 2012; INT 1 2012; INT 2  
2012) National Electrical Safety Code

IEEE C62.41.1 (2002; R 2008) Guide on the Surges  
Environment in Low-Voltage (1000 V and  
Less) AC Power Circuits

IEEE C62.41.2 (2002) Recommended Practice on  
Characterization of Surges in Low-Voltage  
(1000 V and Less) AC Power Circuits

IEEE Stds Dictionary (2009) IEEE Standards Dictionary: Glossary  
of Terms & Definitions

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C82.11 (2002) American National Standard for  
High-Frequency Fluorescent Lamp  
Ballasts--Supplements

ANSI/IEC C78.81 (2010) American National Standard for  
Electric Lamps--Double-Capped Fluorescent  
Lamps--Dimensional and Electrical  
Characteristics

ANSI/IEC C78.901	(2005) American National Standard for Electric Lamps - Single Base Fluorescent Lamps--Dimensional and Electrical Characteristics
ANSI/NEMA C78.LL 1256	(2003) Procedures for Fluorescent Lamp Sample Preparation and the Toxicity Characteristic Leaching Procedure (TCLP)
NEMA 250	(2008) Enclosures for Electrical Equipment (1000 Volts Maximum)
NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)	
NFPA 70	(2011; Errata 2 2012) National Electrical Code
U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)	
Energy Star	(1992; R 2006) Energy Star Energy Efficiency Labeling System
UNDERWRITERS LABORATORIES (UL)	
UL 1598	(2008; Reprint Jan 2010) Luminaires
UL 844	(2006; Reprint Sep 2011) Standard for Luminaires for Use in Hazardous (Classified) Locations
UL 935	(2001; Reprint Nov 2011) Standard for Fluorescent-Lamp Ballasts

## 1.2 DEFINITIONS

- a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, are as defined in **IEEE Stds Dictionary**.
- b. Average life is the time after which 50 percent has failed and 50 percent has survived under normal conditions.
- c. Total harmonic distortion (THD) is the root mean square (RMS) of all the harmonic components divided by the total fundamental current.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section **01 33 00 SUBMITTAL PROCEDURES**:

Employ the terminology, classifications, and methods prescribed by the **IES HB-10**, as applicable, for the lighting system specified in data, drawings, and reports.

#### SD-02 Shop Drawings

Submit Fabrication Drawings for the following items consisting of fabrication and assembly details to be performed in the factory.

Enclosed and Gasketed Vapor-Tight Fixtures

#### SD-03 Product Data

Fluorescent lighting fixtures; G

Fluorescent electronic ballasts; G

Fluorescent lamps; G

Energy Efficiency

Submit Equipment and Performance Data for incandescent lighting fixtures in accordance with paragraph entitled, "Related Requirements," of this section.

Submit Manufacturer's catalog data for the following items:

Enclosed and Gasketed Vapor-Tight Fixtures

#### SD-04 Samples

Lighting fixtures, complete with lamps and ballasts; G

#### SD-06 Test Reports

Operating test

Submit test results as stated in paragraph entitled "Field Quality Control."

### 1.4 QUALITY ASSURANCE

#### 1.4.1 Fluorescent Electronic Ballasts

Submit ballast catalog data as required in the paragraph entitled "Fluorescent Lamp Electronic Ballasts" contained herein. As an option, submit the fluorescent fixture manufacturer's electronic ballast specification information in lieu of the actual ballast manufacturer's catalog data. Include published specifications and sketches, which cover the information required by the paragraph entitled "Fluorescent Lamp Electronic Ballasts" herein. This information may be supplemented by catalog data if required, containing a list of vendors with vendor part numbers.

#### 1.4.2 Lighting Fixtures, Complete With Lamps and Ballasts

Submit one sample of each fixture type indicated for inspection, review, and approval. Retain the sample for comparison against the remainder of the fixtures. The sample may be used in the final fixture installation.

#### 1.4.3 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory for "should" wherever it appears. Interpret

references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Provide equipment, materials, installation, and workmanship in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

#### 1.4.4 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship, which have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period includes applications of equipment and materials under similar circumstances and of similar size, on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, provide products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

##### 1.4.4.1 Alternative Qualifications

Products having less than a 2-year field service record are acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

##### 1.4.4.2 Material and Equipment Manufacturing Date

Do not use products manufactured more than 3 years prior to date of delivery to site, unless specified otherwise.

##### 1.4.4.3 Energy Efficiency

Comply with National Energy Policy Act and Energy Star requirements for lighting products. Submit data indicating lumens per watt efficiency and color rendition index of light source.

#### 1.5 WARRANTY

Support the equipment items with service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

##### 1.5.1 Electronic Ballast Warranty

Furnish the electronic ballast manufacturer's warranty, for not less than 5 years from the date of manufacture of the electronic ballast. Ballast assembly in the lighting fixture, transportation, and on-site storage is not to exceed 12 months, thereby permitting 4 years of the ballast 5 year warranty to be in service and energized. State in the warranty that the manufacturer agrees to exchange a malfunctioning ballast and promptly ship the replacement to the using Government facility, said replacement ballast being identical to, or an improvement upon, the original design of the malfunctioning ballast.



## PART 2 PRODUCTS

## 2.1 PRODUCT STANDARDS

Provide incandescent lighting fixtures conforming to [UL 1598](#). Provide fixtures in hazardous areas conforming to [UL 844](#).

Furnish lighting fixtures completely assembled with wiring and mounting devices and ready for installation at the locations noted. Design and equip recessed fixtures in suspended ceilings for installation in the type of ceiling in which the fixture is to be installed. Design fixtures to be supported independent of the ceiling. Equip fixtures with the lamps required.

## 2.2 FLUORESCENT LIGHTING FIXTURES

Provide fluorescent fixtures, conforming to [UL 1598](#) with electronic ballasts unless specifically indicated otherwise.

## 2.2.1 Fluorescent Lamp Electronic Ballasts

Provide electronic ballasts, meeting as a minimum, the following characteristics:

- a. Provide ballasts complying with [UL 935](#), [ANSI C82.11](#), [NFPA 70](#), and [CEC Title 24](#) unless specified otherwise. Provide 100 percent electronic high frequency type ballasts with no magnetic core and coil components, which provide transient immunity as recommended by [IEEE C62.41.1](#) and [IEEE C62.41.2](#). Design ballast for the wattage of the lamps used in the indicated application. Design ballasts to operate on the voltage system to which they are connected.
- b. A power factor of 0.95 (minimum).
- c. Operates at a frequency of 20,000 Hertz (minimum), and is compatible with and not cause interference with the operation of occupancy sensors or other infrared control systems. Provide ballasts operating at or above 40,000 Hertz where available.
- d. Light regulation of plus or minus 10 percent lumen output with a plus or minus 10 percent input voltage regulation. Ensure ballasts have 10 percent flicker (maximum) using any compatible lamp.
- e. A ballast factor between 0.85 (minimum) and 1.00 (maximum). Current crest factor - 1.7 (maximum).
- f. UL listed Class P with a sound rating of "A."
- g. Include circuit diagrams and lamp connections displayed on the ballast.
- h. Provide programmed start ballasts.
- i. Provide ballasts for T-5 and smaller lamps with end-of-life protection circuits as required by [ANSI/IEC C78.81](#) and [ANSI/IEC C78.901](#) as applicable.
- j. Provide ballasts capable of starting and maintaining operation at a minimum of 0 degrees F unless otherwise indicated.

- k. Provide electronic ballasts with a full replacement warranty of 5 years from date of manufacture as specified in paragraph entitled "Electronic Ballast Warranty" herein.

#### 2.2.1.1 T-5 Lamp Ballast

- a. Total harmonic distortion (THD): 10 percent (maximum).
- b. Input wattage.
  - 1. 121 watts (maximum) when operating two FP54T5H0 lamps
  - 2. 65 watts (maximum) when operating two FP28T5 lamps
- c. Ballast system efficacy (lm/w).
  - 1. 83 when operating two FP54T5H0 lamp
  - 2. 89 when operating two FP28T5 lamps

#### 2.2.2 Fluorescent Lamps

- a. Provide T-5 high performance low mercury lamps rated 28/54 watts (as indicated), 3050/5000 initial lumens (minimum), CRI of 85 (minimum), color temperature of 3500 K, with an average rated life of 20,000 hours. Provide low mercury lamps which have passed the EPA Toxicity Characteristic Leachate Procedure (TCLP) for mercury by using the lamp sample preparation procedure described in [ANSI/NEMA C78.LL 1256](#).

Average rated life is based on 3 hours operating per start.

#### 2.3 INCANDESCENT LIGHTING FIXTURES

Use of incandescent lamps and fixtures is prohibited, unless specifically indicated otherwise. [UL 1598](#).

#### 2.4 SUSPENDED FIXTURES

Provide hangers capable of supporting twice the combined weight of fixtures supported by hangers. Provide with swivel hangers to ensure a plumb installation, cadmium-plated steel with a swivel-ball tapped for the conduit size indicated. Provide hangers which allow fixtures to swing within an angle of [45 degrees](#). Brace pendants [4 feet](#) or longer provided in shops or hangers to limit swinging. Provide single-unit suspended fluorescent fixtures with twin-stem hangers. Provide multiple-unit or continuous row fluorescent fixtures with tubing or stem for wiring at one point and a tubing or rod suspension provided for each unit length of chassis, including one at each end. Provide rods with a minimum [0.18 inch](#) diameter.

#### 2.5 SUPPORT HANGERS FOR LIGHTING FIXTURES IN SUSPENDED CEILINGS

##### 2.5.1 Wires

[ASTM A641/A641M](#), galvanized regular coating, soft temper, [0.1055 inches](#) in diameter (12 gage).

### 2.5.2 Wires, for Humid Spaces

ASTM A580/A580M, composition 302 or 304, annealed stainless steel 0.1055 inches in diameter (12 gage).

### 2.5.3 Rods

Threaded steel rods, 3/16 inch diameter, zinc or cadmium coated.

## 2.6 EQUIPMENT IDENTIFICATION

### 2.6.1 Manufacturer's Nameplate

Provide each item of equipment with a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

### 2.6.2 Labels

Provide labeled luminaires in accordance with UL 1598 requirements. Clearly mark all for operation of specific lamps and ballasts according to proper lamp type. Note the following lamp characteristics:

- a. Lamp diameter code (T-4, T-5, T-8, T-12), tube configuration (twin, quad, triple), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
- b. Start type (preheat, rapid start, instant start) for fluorescent and compact fluorescent luminaires.
- c. Correlated color temperature (CCT) and color rendering index (CRI) for all luminaires.

Provide all markings related to lamp type clear and located to be readily visible to service personnel, but unseen from normal viewing angles when lamps are in place. Provide ballasts with clear markings indicating multi-level outputs and indicate proper terminals for the various outputs.

## 2.7 FACTORY APPLIED FINISH

Provide electrical equipment with factory-applied painting systems which, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test.

## 2.8 ENCLOSED AND GASKETED VAPOR-TIGHT FIXTURES

Provide enclosed and gasketed vapor-tight fixtures suitable for wet or damp locations consisting of a cast-aluminum body, cap or matching outlet box, porcelain lampholder, glass enclosing globe, cork gaskets, and cast-aluminum guards for wall, ceiling, or pendant mounting in accordance with UL 1598 and NFPA 70.

Furnish exposed cast aluminum outlet boxes for wall- and ceiling-mounted fixtures with four tapped hubs 90 degrees apart circumferentially, with three cast-aluminum threaded pipe plugs to fit the tapped holes. Provide boxes with ears or lugs for surface mounting to wall or ceiling. Provide body with mounting screws and gasket to ensure a vapor-tight joint between the body and outlet box.

Concealed outlet boxes for wall- and ceiling-mounted fixtures may be standard sheet metal boxes. Provide fixture body with mounting screws and gasket to ensure a vapor-tight joint between the body and outlet box.

Seal body and cap for pendant-mounted fixtures with a gasket at the joint. Provide cast aluminum cap with top hub tapped for 1/2 inch tapered iron pipe threads.

Furnish cast aluminum exposed outlet boxes for pendant-mounted fixtures with the fixtures with four tapped hubs 90 degrees apart circumferentially, with three cast-aluminum threaded pipe plugs to fit the tapped holes. Supply boxes with ears or lugs for surface mounting to the ceiling. Provide cast aluminum outlet-box covers for concealed and exposed outlet boxes with the center hub tapped for 1/2 inch tapered iron pipe threads. Provide cover and outlet box with mounting screws and gasket to ensure a vapor-tight joint between the cover and outlet box. Also provide 1/2 inch galvanized rigid steel conduit stem.

Provide clear nondiffusing heat-resistant glass enclosing globe molded in one piece into a cylindrical shape with a closed bowl-shaped bottom and an open molded top bead or thread. Make edges of the open end either ground or molded to a smooth, true surface that will ensure a vapor-tight joint when the globe is fastened to the gasketed body.

Provide a cast-aluminum guard of the same shape as the glass enclosing globe which is affixed to the fixture body with threads or setscrews.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Ensure all electrical installations conform to IEEE C2, NFPA 70, and to the requirements specified herein.

#### 3.1.1 Lamps

Deliver lamps of the type, wattage, and voltage rating indicated to the project in the original cartons and installed just prior to project completion. Replace lamps installed and used for working light during construction prior to turnover to the Government if more than 15 percent of their rated life has been used. Test the lamps for proper operation prior to turn-over and replace if necessary with new lamps from the original manufacturer. Provide 10 percent spare lamps of each type from the original manufacturer.

#### 3.1.2 Lighting Fixtures

Set lighting fixtures plumb, square, and level with ceiling structure and walls, in alignment with adjacent lighting fixtures, and secure in accordance with manufacturers' directions and approved drawings, in conformance with the requirements of NFPA 70. Mounting heights specified or indicated are to the bottom of fixture for ceiling-mounted fixtures and to center of fixture for wall-mounted fixtures. Obtain approval of the exact mounting for lighting fixtures on the job before commencing installation and, where applicable, after coordinating with the type, style, and pattern of the ceiling being installed. Independently support recessed and semi-recessed fixtures from the building structure by a minimum of four wires or rods per fixture and located near each corner of each fixture. Ceiling grid clips are not allowed as an alternative to

independently supported light fixtures. Independently support round fixtures smaller in size than the ceiling grid from the building structure by a minimum of four wires or rods per fixture spaced approximately equidistant around the fixture. Do not support fixtures by ceiling acoustical panels. Where fixtures of sizes less than the ceiling grid are indicated to be centered in the acoustical panel, support such fixtures independently and provide at least two 3/4 inch metal channels spanning, and secured to, the ceiling tees for centering and aligning the fixture. Provide wires or rods for lighting fixture support in this section.

### 3.2 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Specify painting in Section 09 90 00.00 98 PAINTING AND COATING.

### 3.3 FIELD QUALITY CONTROL

Upon completion of installation, verify that equipment is properly installed, connected, and adjusted. Conduct an operating test to show that equipment operates in accordance with requirements of this section.

-- End of Section --

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## DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

## SECTION 28 05 26.00 40

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## SECTION 28 05 26.00 40

## GROUNDING AND BONDING

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## AMERICAN WELDING SOCIETY (AWS)

**AWS A5.8/A5.8M** (2011) Specification for Filler Metals for  
Brazing and Braze Welding

## ASTM INTERNATIONAL (ASTM)

**ASTM B3** (2001; R 2007) Standard Specification for  
Soft or Annealed Copper Wire

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

**NFPA 70** (2011; Errata 2 2012) National Electrical  
Code

## U.S. DEPARTMENT OF DEFENSE (DOD)

**MIL-STD-889** (1976; Rev B; Notice 2 1988; Notice 3  
1993) Dissimilar Metals

## UNDERWRITERS LABORATORIES (UL)

**UL 467** (2007) Grounding and Bonding Equipment

## 1.2 GENERAL REQUIREMENTS

Section **26 00 00.00 20** BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

Section **05 05 23.00 98** METAL FASTENINGS applies to work specified in this section.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section **01 33 00**  
SUBMITTAL PROCEDURES:

**SD-01 Preconstruction Submittals**

Submit material, equipment, and fixture lists including manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site

information.

#### SD-02 Shop Drawings

Submit [Record Drawings](#) in accordance with paragraph entitled, "Drawings," of this section.

#### SD-03 Product Data

Submit equipment and performance data for the following items including life, test, system functional flows, safety features, and mechanical automated details.

Submit Manufacturer's catalog data for the following items:

[Ground Wires](#)

[Connectors and Fasteners](#)

[Bonding](#)

#### SD-06 Test Reports

Submit Test Reports for the following tests on grounding systems in accordance with the paragraph entitled, "Field Tests," of this section. Within the report include certified record of ground-resistance tests on each driven ground rod, ground rod assembly, and other grounding electrodes. Include within the record the number of rods driven and their depth at each location to meet the required resistance-to-ground measurements specified. Include a statement describing the condition of the soil at the time of measurement.

[Bond Resistance Test](#)

[Ground Isolation Test](#)

[Continuity Isolation Test](#)

#### SD-08 Manufacturer's Instructions

Submit Manufacturer's instructions including special provisions required to install equipment components and system packages. Within special notices, detail impedances, hazards and safety precautions.

### 1.4 DRAWINGS

[Record Drawings](#) must indicate the location of ground rods, mats, grids, building ground bus, supplementary grounding electrodes, steel building columns, and other metal structures connected to the grounding system.

Identify the location of each ground rod and ground-rod assembly and other grounding electrodes by letter in alphabetical order and keyed to the record of ground-resistance tests.



## PART 2 PRODUCTS

### 2.1 GROUND WIRES

Ground wires must be in accordance with Section 26 05 00.00 40 COMMON WORK RESULTS FOR ELECTRICAL.

Ground and bond wires for substations, main panels and distribution points must be annealed bare copper conforming to ASTM B3, stranded, with 98 percent conductivity. Wire size must be in accordance with the grounding requirements of NFPA 70.

Ground wires for equipment receptacles for noncurrent carrying hardware, installed in conduit must be soft drawn copper, in accordance with ASTM B3, stranded, with green insulation. Note wire size.

### 2.2 CONNECTORS AND FASTENERS

Grounding and bonding fasteners and connectors must conform to the requirements of UL 467, and Section 26 05 00.00 40 COMMON WORK RESULTS FOR ELECTRICAL.

Grounding and bonding fasteners must be copper or bronze.

Bonding straps and jumpers must be copper and have a cross-sectional area of not less than No. 6 AWG. Bonding straps and jumpers for shock-mounted devices with pivot, hinged or swivel joints must be made of woven-wire braid wire.

## PART 3 EXECUTION

### 3.1 BONDING AND GROUNDING

Bonding and grounding requirements must be in accordance with NFPA 70.

### 3.2 BUILDING GROUNDS

Steel framework of the VAB is considered to be grounded to an existing counteroise grounding grid. Existing system includes electrically connected grounding conductor from steel columns and extending around the perimeter of the building.

### 3.3 EQUIPMENT GROUNDING

In addition to the green colored equipment grounding conductor required in each raceway and sized in accordance with Table 250.122 of the NEC, each panelboard/ switchboard enclosure, transformer housing, motor housing, disconnect, starter, and other electrical equipment, addressed under this contract, must be bonded to the grounding system with a stranded copper conductor, routed external to the feeder raceway.

Metallic raceway systems must have electrical continuity with equipment individually and be directly connected to the building ground, independent of the raceway system.

Individually and directly connect enclosures for panelboards to the building ground. Grounding conductor must not be less than No. 2 AWG and be connected from the building ground to a copper ground-bus terminal strip located in each panelboard.

Polarized receptacles, lighting fixtures, and equipment enclosures must be grounded with an identified (green color) insulated conductor, not smaller than No. 12 AWG, connected to the branch circuit ground-bus terminal strip. Ground-bus terminal strip in each panelboard enclosure must be isolated and independent of the system neutral terminal strip.

Indoor substations, transformers, switchboard frames, switchgear assemblies, motors, motor control centers, air compressors, air handlers, refrigerated air dryers, generators, frames and tracks of cranes, and platforms must be individually and directly connected to the building ground. Current-carrying capacity of the grounding conductor must be the same as the current-carrying capacity of the power conductors for circuits utilizing power lines size No. 2 AWG and smaller. For circuits with power wiring larger than No. 2 AWG, the grounding conductor must be in accordance with NFPA 70, except that the grounding conductor must not be smaller than No. 2 AWG.

Noncurrent carrying metallic parts of electrical equipment, including metallic cable sheaths, conduit, raceways, and electrical structural members, must be bonded together and connected to the ground grid or ground connection rods.

Install secure ground systems for power and instrumentation. Independently connect each system to the building counterpoise as shown.

Secure ground systems must consist of unsplined ground wires in individual welded or epoxied conduit runs from the secure area to the building counterpoise. Welding and epoxying must conform to Section 26 05 00.00 40 COMMON WORK RESULTS FOR ELECTRICAL.

### 3.4 GROUNDING CONNECTIONS

Ground connections must be bonded connections in accordance with paragraph entitled, "Bonding," of this section.

Weld ground connections that are buried or in inaccessible locations.

Bolt connections in accessible locations. Connections to steel building columns in accessible locations must be cast-copper-alloy clamp lugs bolted or exothermically fusion-welded to the structure.

Clean, grease, and remove foreign matter from ground connection surfaces. Do not penetrate clad material in the cleaning process. Make connection between like metals where possible. Where dissimilar metals are welded, brazed, or clamped, follow the weld kit manufacturer's instructions. Connections between dissimilar metals must not produce galvanic action in accordance with MIL-STD-889.

### 3.5 BONDING

#### 3.5.1 Type of Bonds

Accomplish bonding of metal surfaces by brazing, welding, clamping or structural joining methods.

##### 3.5.1.1 Brazing

Brazing solder must conform to AWS A5.8/A5.8M.

#### 3.5.1.2 Welding

Welding must be by the exothermic process. Within the welding procedure, include the proper mold and powder charge and conform to the manufacturer's recommendations.

Welding processes must be of the exothermic fusion type that will make a connection without corroding or loosening. Process must join all strands and not cause the parts to be damaged or weakened. Completed connection or joint must be equal or larger in size than the conductors joined and have the same current-carrying capacity as the largest conductor. Paint buried ground connections with a bitumastic paint.

#### 3.5.1.3 Clamping

In external locations, use clamping only where a disconnect type of connection is required. Connection device may utilize spring-loaded jaws or threaded fasteners. Construct device such that positive contact pressure is maintained at all times. Use machine bolts with spring-type lockwashers.

#### 3.5.1.4 Structural Joining Methods

Consider joints made with high-strength structural bolts, and clean unpainted faying surfaces sufficiently bonded. Install a jumper across the joint in the form of a **No. 4 AWG** bare copper wire exothermically welded at each end to the surfaces involved spanning the connection wire jumpers used across joints employing miscellaneous machine bolts.

#### 3.5.2 Cleaning of Bonding Surfaces

Thoroughly clean surfaces that comprise the bond before joining. Apply an appropriate abrasive with gentle and uniform pressure to ensure a smooth and uniform surface. Do not remove excessive metal from the surface. Clean clad metals in such a manner that the cladding material is not penetrated by the cleaning process. Then clean bare metal with an appropriate solvent to remove any grease, oil, dirt, corrosion preventives, and other contaminants. Bond to the cleaned area must be made within one hour after cleaning. Seal joint and refinish the exposed surfaces within two hours of exposure to prevent oxidation. When additional time is required, apply a corrosion preventive compound until the area can be refinished.

#### 3.5.3 Bonding Straps and Jumpers

Install jumpers such that the vibration by the shock-mounted device will not change its electrical characteristics.

Braze or Weld bonds for outdoor locations unless a disconnect type of connection is required. When a disconnect is required, use clamping with bolts. Insert a tooth-type lockwasher between the strap and metallic member for each bolt.

Bond straps directly to the basic structure and do not penetrate any adjacent parts. Install straps in an area that is accessible for maintenance.

Use single straps for the bonds and install such that they will not

restrict movement of structural members. Do not connect two or more straps in series.

Install straps such that they will not weaken structural members to which they are attached.

#### 3.5.4 Equipment and Enclosure Bonding

Each metallic enclosure and all electrical equipment must be bonded to ground. At least one copper connection must be made from the system ground point to one or more enclosures in the area such that all enclosures and equipment provide a low-impedance path to ground when properly bonded together.

#### 3.5.5 Bonding of Conduit and Raceway Systems

Bond all metal conduit, fittings, junction boxes, outlet boxes, armored and metal sheathed cable, and other raceways. Take care to ensure adequate electrical contact at the joints and terminations.

##### 3.5.5.1 Rigid Metal Conduit and Terminations

Threaded connections must be wrench-tight and there must be no exposed threads. Ream all ends of the conduit to remove burrs and rough edges. Conduits entering boxes and enclosures must be bonded to the box with locknuts and grounding-type bushings. Locknuts that gouge into the metal box when tightened are not acceptable.

Conduit systems that are interrupted by PVC dielectric links must be bonded separately on either side of the link. Dielectric link must not be jumpered.

##### 3.5.5.2 Flexible Metal Conduit

Flexible conduit must have an integral grounding conductor.

#### 3.5.6 Protection of Finished Bonds

Protect finished bonds by painting to match the original finish after the bond is made.

### 3.6 FIELD TESTS

Perform the following tests in the presence of the Contracting Officer.

#### 3.6.1 Bond Resistance Test

Resistance of any bond connection must not exceed 0.5 milliohm. Rework bonds that exceed this resistance at no additional cost to the Government.

#### 3.6.2 Ground Isolation Test

Test ground systems for isolation from other ground systems.

#### 3.6.3 Continuity Isolation Test

Perform continuity test on all power receptacles to ensure that the ground terminals are properly grounded to the facility ground system.

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## SECTION 41 22 23.19

## PLATFORM HOISTS SYSTEMS

## PART 1 GENERAL

## 1.1 SUMMARY

It is not the intent to specify herein all details of design and construction. It shall be the responsibility of the hoist manufacturer to ensure that the equipment has been designed and constructed in accordance with all engineering codes, standards, Government regulations, and as a minimum in accordance, guidance and recommendations of applicable portions of CMAA 70 specifications for Class C services and the WRTB.

The contractor shall have full responsibility for compliance with the requirements of the specifications. Review of drawings, catalog, or specifications by Designated NASA Representative with regard to general design and controlling dimensions does not constitute acceptance of any design, material, or equipment that will not fulfill the function or performance requirements established herein.

## 1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B17.1 Keys and Keysets

## AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2010; Errata 2010) Structural Welding Code - Steel

AWS D14.1/D14.1M (2005) Specification for Welding Industrial and Mill Cranes and Other Material Handling Equipment

## ASME INTERNATIONAL (ASME)

ASME B30.7 (2011) Winches

ASME B30.10 (2009) Hooks

ASME NOG-1 (2010) Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder)

## ASTM INTERNATIONAL (ASTM)

ASTM A1023/A1023M (2009) Standard Specification for Stranded



Carbon Steel Wire Ropes for General  
Purposes

CRANE MANUFACTURERS ASSOCIATION OF AMERICA (CMAA)

CMAA 70 (2010) Specification for Top Running  
Bridge and Gantry Type Multiple Girder  
Electric Overhead Traveling Cranes, No. 70

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 519 (1992; R 1993; Errata 2004) Recommended  
Practices and Requirements for Harmonic  
Control in Electrical Power Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (2008) Enclosures for Electrical Equipment  
(1000 Volts Maximum)

NEMA ICS 6 (1993; R 2011) Enclosures

NEMA MG 1 (2011) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2011; Errata 2 2012) National Electrical  
Code

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.179 Overhead and Gantry Cranes

UNDERWRITERS LABORATORIES (UL)

UL 508C (2002; Reprint Nov 2010) Power Conversion  
Equipment

WIRE ROPE TECHNICAL BOARD (WRTB)

WRTB (2005) Wire Rope Users Manual 4th Edition

### 1.3 SYSTEM DESCRIPTION

#### 1.3.1 General

This specification describes the performance requirements for the design, construction, installation and testing of four (4) new hoisting systems used for raising and lowering work platforms located in VAB High Bay 3. Each hoist within a single hoist system shall be capable of independent operation or in synchronized combination with other hoists in the same system.

Two hoist systems will be lifting main extensible platforms. Each system will have four hoists rated for 75 tons **each** for a total of eight (8) 75 ton hoists.

Two hoist systems will be lifting elevator access platforms. Each system will have four hoists rated for 7.5 tons **each** for a total of eight (8) 7.5

ton hoists. This is an adjustable access platform located at various elevator landings.

These towers are located in the Vehicle Assembly Building (VAB), an existing 525' tall enclosed building, VAB, that processes aerospace vehicles in preparation for movement to a launch pad. The towers contain new platforms stacked at multiple levels within each of the two separate towers.

This specification assumes the VAB High Bay 3 platforms will be installed by a separate contract, which may be initiated earlier or concurrent with the work described herein. Coordination with this work with the VAB High Bay 3 project by the hoist manufacturer is required. This shall allow for the interface and clearance within the platform structures including the hoist reeving, its lower block and slings. This work is shown on drawing 79K39267 and specification 79K39268.

The contractor shall make inspections and field measurements required to assure compatible system interfaces. A full functional test of these interfaces, including full platform operational testing shall be demonstrated during acceptance testing (reference paragraph 3.4.4.2 of this section).

#### 1.3.1.1 Hoist Capacity

The hoist capacity was selected based on enhanced safety needs to accommodate NASA critical lift requirements. These requirements are related to special safety requirements needed to support platform operations and the need to have personnel on the platform during movement.

Safety rational dictated requirements to accommodate the failure of any one of the four hoists during tandem platform lifting operations. During this failure scenario the platform is assumed to tip (based on worst case center-of-gravity location of the platform) and resulting in only two hoists to support the platform. The tipping platform is designed to safely wedge itself into building columns. Personnel on the moving platform will be safe based on this limited tipping (and they will be tethered to the platform with safety harnesses).

Based on this enhanced safety design the platform hoists will comply with the following:

- hoists are rated for twice the normal capacity needed to lift a platform. This accommodates two hoists holding the platform should one hoist fail.
- hoist holding brakes shall be designed for 150 percent of the torque needed to lift the rated load (special testing for the hoist brakes is required)

#### 1.3.2 Platform Operation

Platforms shall be normally fixed in place and pinned to structural columns of the building. The platforms serve to provide access to various work stations around the launch vehicle by personnel. During normal work activities, the platforms hoist slings are detached and withdrawn. Periodically it is necessary to raise or lower a platform to a different elevation within the stack.

Platforms within the stack can be repositioned within the elevation limits

of the platform directly above or directly below. Repositioning of a platform within the stack shall be accomplished by attaching slings from the four overhead hoists to four corners of the platform to pick up the platform. After the slings are securely attached to the platform, the hoist control system energizes the four hoists to lift the platform and relieve the pin pressure at the platform connections to the columns. After the pins are removed from the column connections, the platform load is supported by the hoist slings. The platform is free to be repositioned by the hoisting system.

At the new location, the platform is reconnected (pinned) to the building structure and the hoisting slings disconnected and withdrawn from the platform. The hoist control system shall provide normal speed and inching speeds for the four hoists synchronized operation and individual hoist operation for final positioning and pin alignment or removal at individual platform corners. A no-load or empty hook speed is provided for rapid hook positioning. Each tower contains platforms installed at varying elevations in the tower and stacked on top of each other and attached to the same building columns. During platform hoisting and positioning operations, a limited number of personnel will be riding the platforms to disconnect, align and connect the platform to the building columns before removing the hoist slings.

#### 1.3.3 Extensible Platforms

There are two (2) extensible platform towers having a stack of ten (10) platforms in each tower one at a time. Each platform is approximately 38'-0" by 76'-0" wide with a total weight of 225,000 pounds.

The platforms have similar shapes and geometry but have differences in total weight and center of gravity.

The physical differences in weight and center of gravity will necessitate differences in hoist line pull during platform movements. Each independent control system shall synchronize speeds between each of the four hoists regardless of actual hoist line pull. In this manner the four hoists attached to the four corners of each platform will raise and lower the platform and maintain the platform in a level state.

#### 1.3.4 Elevator Access Platforms

There are two (2) elevator access platform towers having a stack of ten (10) platforms in each. Each platform is approximately 19'-0" by 24'-0" wide with a total weight of 30,000 pounds.

The platforms have similar shapes and geometry but have differences in total weight and center of gravity. The physical differences in weight and center of gravity will necessitate differences in hoist line pull during platform movements. Each independent hoist control system shall synchronize speeds between each of the four hoists regardless of hoist line pull. In this manner the four hoists attached to the four corners of each platform will raise and lower the platform and maintain the platform in a level state.

#### 1.4 SUBMITTALS

The submittal requirements for the 75 ton hoists include engineering details needed for design and fabrication of a custom engineered and manufactured hoists. The submittals are specific to provide approval of

structural and mechanical items for detailed components. The submittal requirements for the electric 7-1/2 ton hoists include standard manufacturers literature needed for selection and approval of commercial equipment and engineering details needed for design and fabrication of custom engineered and manufactured equipment.

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

#### SD-02 Shop Drawings; G

General Arrangement Drawings shall show capacities, duty class, and details for all of the main components of the hoist including parts descriptions, manufacturer's model numbers, and shall include clearances and interfaces within the facility, lifts, speeds, and weight breakdown. Weights shall be shown for: hoist and load block; total net weight. The hoist shall be shown in plan, side and end elevation.

Submit shop drawings showing all principal mechanical components, principal dimensions, details of structural connections, and related component details. Include complete schematic wiring diagram with description of operation. Manufacturer's catalog data will suffice for items of standard manufacturer.

#### Electrical Schematics

The drawings shall integrate all control equipment to provide clear and continuous control logic between sheets. The compiling of individual manufacturers drawings as a substitute for integrated drawings will not be acceptable. All electrical schematics shall be provided such that a functional analysis can be performed.

Documentation for [microprocessor](#)-based control systems

Documentation for Microprocessor-Based Control Systems, if provided, shall include complete manufacturer's catalog data which shall include definitions of their functions and their relation to the integrated control system. Programmed parameters shall be provided, along with complete instruction on programming method.

#### As-Built Drawings

On or before completion date of the contract, the Contractor shall submit to the designated NASA representative a complete set of as-built drawings in accordance with the Contract which incorporates all comments, annotations, conditions of approval and corrections. The set shall include assembly drawings with part list, detail drawings on custom engineered components, and electrical drawings including electrical schematics and wiring diagrams.

#### SD-03 Product Data; G

Product data shall be provided for all assemblies and subassemblies including but not limited to the following:

Electric Wire Rope Hoist  
Application software  
Drive Controllers  
Control Parameter Settings  
Control Components  
Hoist Electrification  
Control Panels  
Motors  
Brakes  
Couplings  
UPS  
Capacity Overload Protective Device  
Hoist Limit Switches  
Master Switches  
Wire Rope

Batteries - The Contractor shall submit a list of devices that contain batteries. This list shall indicate the estimated life of each individual battery, location of each battery, and the procedure for replacement of each battery. This can be supplied by the devices cut sheets.

#### SD-05 Design Data; G

##### Hoist Structural Support Calculations

Submit floor loading structural design calculations verifying the size of structural members, structural supports and components for the hoist drive assembly as imposed to the concrete floor slabs. Include stress and loading diagrams.

Hoist mechanical and structural calculations for custom engineered equipment to component level

#### SD-06 Test Reports; G

Shop Test Procedure  
Post-Erection Inspection  
No-Load Test  
Operational Tests  
Rated Load Speed Test  
Hook NDE Report  
Acceptance Test Procedure

#### SD-07 Certificates; G

Hazardous Material  
Brake Settings  
Loss of Power Tests  
Hook Proof Load Test  
Wire Rope Test

#### SD-10 Operation and Maintenance Data; G

Hoist systems, all mechanical and electrical components See paragraph 3.5.

Submit Data Package 5 as specified in Section 01 78 23 OPERATION

## AND MAINTENANCE DATA.

## 1.5 QUALITY ASSURANCE

All structural, machine shop and assembly work shall be neat, accurate and equal in all respects to the best heavy machine tool practice and shall conform to the best practice of modern fabrication shops.

Where two or more units of the same class of equipment are required under this section and other sections of the specifications, these units shall be products of a single manufacturer.

Metal fits, tolerances, and finishes shall conform to those indicated on the approved drawings.

## 1.5.1 Contractor Qualifications

Custom manufactured hoists and its related systems shall be designed and manufactured by a company with a minimum of 10 years of specialized experience that is regularly engaged in the designing and manufacturing of hoists for material handling of high dollar items for aerospace, nuclear, chemical or steel mill industries. Only companies experienced in this type of development and manufacturing and their applications will be considered qualified to meet requirements of the Contract Documents.

All software developed specifically for this project shall be done by personnel with a minimum of three years experience in writing and interfacing software on the development platforms chosen.

The Contractor shall supply company credentials and experience levels of individual(s) performing design and software development for this project for approval by the Contracting Officer.

## 1.5.2 Inspections

All parts shall be inspected to ensure compliance with the finishes and tolerances established by the approved shop drawings. The material to be furnished shall be subject to inspection and tests in the mill, shop and field by Government Inspectors. When materials and workmanship do not conform to the specification requirements, the Government reserves the right to reject material or workmanship, or both, at any time before final acceptance of the hoists. Parts which fail to conform to the approved shop drawings shall be replaced with acceptable parts unless a specific method of repair is authorized in writing by the designated NASA representative.

Certification and inspection test reports shall be submitted to the designated NASA representative for approval on the following items. Approved certification and inspection test reports shall be submitted in the Acceptance Data Package.

## 1.5.3 Hooks, Proof Load and Throat Spread Measurement

Prior to acceptance testing, hooks shall be individually proof load tested in accordance with [ASME B30.10](#).

A throat dimension base measurement shall be established by installing two tram points and measuring the distance between these tram points (+/- 1/32 inch). This base dimension shall be recorded. The distance between tram points shall be measured after load test. The hook shall be able to

withstand the proof load test without permanent deformation.

As part of acceptance testing, the hoist shall be proof load tested to 125 percent. The hooks shall be measured for hook throat spread before and after testing. An increase in the hook throat opening from the base measurement is cause for rejection.

#### 1.5.4 Non-Destructive Examination of Mechanical Components

Prior to assembly, all hooks, hook nuts and sheave pins, hoist drum shafts, upper block sheave pins, and hoist shafts shall receive non-destructive examination (NDE) in accordance with ASME NOG-1 Section 7100 and Table 7210-1.

After acceptance testing the hook shall be given an additional MT or PT examination after 125% proof load test. Hook disassembly is not required.

Acceptance criteria shall be in accordance with ASME NOG-1 Section 7100.

#### 1.5.5 Welders Certification and NDT of Welding

Welders certifications and NDT reports on welds shall be completed and available for inspection by Government Inspectors. All welder certification and NDT reports shall be submitted with the hoist data package, at the end of the contract.

Welders and welding operations must be qualified in accordance with AWS D1.1/D1.1M or AWS D14.1/D14.1M. Allowable stress values must comply with CMAA 70.

#### 1.5.6 Certificates of Compliance

Certificates of Compliance shall be provided on the following items:

- a. Electrical Components and Controls in compliance with contract requirements.
- b. Motors - Hoist motors, wiring, contract drawings, over-current protection, and grounding shall conform to NFPA 70, and to UL standards; the label or listing with re-examination of the UL shall be accepted as evidence that the materials conform to this requirement and to NFPA 70.
- c. Shop testing and acceptance testing in compliance with contract requirements.

#### 1.5.7 Certificates

- a. Certification of actual wire rope breaking strength for each supplied wire rope, with traceable identification to the wire rope manufacturer.
- b. Certification that the hoist systems contains no hazardous material, asbestos, cadmium, lead, elemental mercury, or PCBs.
- c. Certification of brake settings, including the allowable range of and the initial setting of each.
- d. Certification and acceptance of NDE of components in accordance with requirements herein.

## 1.6 DELIVERY, STORAGE, AND HANDLING

### 1.6.1 Delivery and Storage

Inspect materials delivered to site for damage; unload and store with minimum handling. Store materials on-site in weather-proof enclosures.

### 1.6.2 Handling

Handle materials in such a manner as to ensure delivery to final location in undamaged condition. Make repairs to damaged materials at no cost to Government.

## PART 2 PRODUCTS

### 2.1 HOISTING SYSTEM COMPONENTS

The 75-ton extensible platform hoists shall be a built-up unit generally made from commercially available or made to order motors, brakes, couplings and gear reducers. These components are engineered together as an assembly mounted on a custom designed and built equipment frame with custom drums and shafts.

The 7-1/2 ton elevator access platform hoists may be a pre-engineered, built to order unit or a built-up unit generally made from commercially available or made to order components. It is the intent of this specification to maximize the use of commercially available equipment to the greatest extent possible.

All equipment shall be built and equipped to accommodate the exceptions, features and capabilities specified herein and on the accompany contract drawings.

#### 2.1.1 General

The hoisting systems shall be comprised of four (4) hoists operated by an electrical control system for raising and lowering a work platform while occupied by a limited number of personnel and equipment. The hoisting system shall incorporate the following features:

FEATURE	EXTENSIBLE PLATFORMS	ELEVATOR PLATFORMS
Hoist Load Rating	75 tons	7-1/2 tons
Duty Service Class	CMAA Class C	CMAA Class C
Drum Surface	Lebus Grooved for multiple layers of wire rope	Grooved, single layer of wire rope
Normal Hook Speed	Variable 0-15 FPM	Variable 0-15 FPM
Inching Hook Speed	variable 0-1.5 fpm	variable 0-1.5 fpm
No-Load Hook Speed	2 ½ x Normal Speed	2 ½ x Normal Speed
Controls	AC flux vector drives	AC flux vector drives



FEATURE	EXTENSIBLE PLATFORMS	ELEVATOR PLATFORMS
Brakes	Elect. @150% Rated Torque	Elect. @ 150% Rated Torque
Safety Switches	Two Upper-limit switches	Two Upper-limit switches
	Control & Final power sw.	Control & Final power sw.
	Gear-opr. Lower-limit sw.	Gear-opr. Lower-limit sw.

## 2.2 COMMON REQUIREMENTS

### 2.2.1 Identification Plates and Signage

Provide manufacturer installed identification plates of non-corrosive metal showing, in clearly legible permanent lettering, the manufacturer's name, model number, capacity rating in pounds, and other essential information.

All electrical enclosures shall be labeled with PPE requirements per Section 26 05 71.00 40, LOW VOLTAGE OVERCURRENT PROTECTIVE DEVICES.

Hoist and corbel signs shall be provided to assist in platforms movement operation using each respective hoist. Each hoist including its respective extensible platforms corbels and elevator landing platforms corbels shall be provided with signage to include the following:

Hoist location signage shall be provided indicating its corresponding platform corner, i.e. NE, NW, SE, and SW. These shall correspond to the hoist control console labels. All hoist location signs shall be visible by the operator standing at the hoist operator's console.

Corbels at all platforms locations shall be labeled according to its location NE, NW, SE, and SW.

Signage shall meet requirements described in the contract drawings.

### 2.2.2 Miscellaneous Equipment Features

Hoist structural support calculations and imposed loads to the building.

Drip pans shall be provided under new components installed under contract that contains oils or grease that has the capability to leak out. This may include oil containment pan or barrier so an oil leak will be contained in local area around the unit.

All couplings with setscrews shall have loctite applied to them and marking putty applied to indicate any loosening.

All belts, chains, and rotating equipment shall have proper covers to prevent inadvertent contact from personnel.

All new Zirk fittings shall be pressure relief fittings.

No plastic tie wraps are permissible on the hoist exterior.

NASA will define any passwords and receive four keys for every lock.

The conduits shall not exceed 90% of NFPA 70 required fill capacity allowing 10% left for additions. A non-conductive messenger cable shall be added to each conduit run to provide future wire pulling capability.

All crimped lugs shall be ring lugs; forked lugs will not be allowed. No wire splices shall be allowed. All termination shall be made at terminal blocks or on electrical devices.

### 2.2.3 Hoist Electrification

Provide enclosures for control panels, controls, and brakes in accordance with NEMA 250 and NEMA ICS 6, Classification Type 12.

All control enclosures and cabinets shall be provided with work lighting. Lighting shall be on interlock switches so that the light comes on when the door to the panel is opened and goes off when the door is shut.

All electronic components and wiring shall be properly labeled to match the drawing. All lights, switches, and components on the hoist control panel shall be properly labeled to designate its purpose. All control panels shall be properly labeled to indicate what components are inside.

The existing building ambient temperature at the location of where the hoists will be located ranges from 40 degrees F to 100 degrees F with 10% to 95% relative humidity. All electronic equipment shall be rated for or above this temperature range for continuous duty. If the electronic equipment cannot meet this temperature requirement then the contractor shall provide environmental equipment on the enclosures to maintain the electronic equipment in proper operating ranges. Provide cooling unit on each control panel. Provide ductwork, etc. inside each enclosure for uniform airflow distribution. The cooling unit shall be designed not to require condensate drain and cool the panel interior to 80 degrees F with all equipment running at full load. Cooling units shall be accessible for regular service and maintenance.

## 2.3 HOIST SYSTEM

### 2.3.1 Design Requirements

Hoist system shall include the following design requirements:

- a. Powered hoists shall include a brake and a controlled braking means, and an overload limiting device.
- b. Design the mainline contactor, along with the power-off/power-on circuitry to remove power from the drive motors, brakes and control circuit. The control circuit shall not operate unless a power-on button is depressed.

### 2.3.2 Material Requirements

Cast Iron with less than 15% elongation shall not be used for components within the load path of the lifted load, with the exception of electric motors, hydraulic related components, and brake wheels.

### 2.3.3 Safety

Comply with the mandatory and advisory safety requirements of ASME B30.7, and 29 CFR 1910.179. The Contractor is responsible for checking the proper operation and condition of safety devices, electrical components, mechanical equipment, and structural assemblies prior to installation. Immediately report any observed defective components and replace.

## 2.4 ELECTRIC WIRE ROPE HOIST

### 2.4.1 Hoisting Ropes

Provide the following:

- a. Rope lengths shall be sufficient to provide required lift of 85 feet per contract drawings and to maintain a minimum of two full wraps of rope at the dead end(s) of the drum, with the block in the geared lower limit position.
- b. The hoist manufacturer shall select the wire rope type. Consideration shall be given to rope lay and compacted strand wire rope suitable for multiple wrapped wire rope drum and rotation - resistant rope suitable number of parts of reeving. Hoisting ropes shall conform to [ASTM A1023/A1023M](#), improved or extra improved plow steel, uncoated, 6 by 37 class construction, with an independent wire rope core. End fittings shall develop 100 percent of the wire rope strength.
- c. All [wire rope](#) shall be inspected prior to installation and post [wire rope test](#). The inspection shall be performed per [ASME B30.7](#) Section 7-2.4.1.
- d. The Wire Rope Users Manual shall be used for all aspects of end fitting attachments, seizing of ends, and wire rope handling.
- e. All bolts next to open edges shall be Ny-lock type or equal self locking.

### 2.4.2 Load Block and Sheaves

The load block shall be an enclosed steel safety type which will shroud the sheave and protect the operator. The sheave assembly shall be mounted on a steel axle and carried on sealed, antifriction bearings. The hook for the 75 ton hoist shall be mounted on a lower block trunnion.

Sheave pitch diameters shall be selected based wire rope size in accordance with the CMAA 70 recommendations. Sheave grooves shall properly support the wire rope circumference.

### 2.4.3 Hook Assembly

Hooks and hook swivels shall be heat-treated alloy steel forgings marked in accordance with [ASME B30.10](#). Hook assembly shall be carried on antifriction bearings to permit free swivel under rated-capacity load without twisting wire rope.

Hook assembly shall include a machined and threaded shaft and swivel lock-nut with a suitable easily removal locking device to prevent nut from backing off.

Hook shall have a spring-loaded, heavy duty, swinger type safety latch such as Bullard Swinger type gate "Rollox" or "Tip-lok" safety latch as applicable, or equal.

Each load block shall be labeled with its ratings capacity.

#### 2.4.4 Wire Rope Drum

Provide steel or ductile cast iron wire rope drum. Drum shall have accurate, machine-cut grooves, cut to depth of wire-rope diameter as recommended by CMAA specifications, with rounded corners of dimension as required for the indicated lift. Drum shall be flanged at each end and shall have enclosed tops and sides to preclude cable binding and jamming. Drum pitch diameter shall be no less than recommended by CMAA 70 Table 4.6.4-1 "Guide for Minimum Pitch Diameter of Drums".

The 7-1/2 ton hoist drum shall be proportioned to store not more than one layer of rope with the load hook at the upper operating limit and shall have not less than two full turns remaining on the drum at the lowest lift elevations, as defined by the setting of the lower limit switch. Wire rope fleet angle shall not be greater than recommended by CMAA 70.

The 75-ton hoist drum shall be proportioned to store all wire rope needed to provide full travel of the hook with not less than two full turns remaining on the drum at its lowest elevation, as defined by the setting of the lower limit switch.

The drum shall provide for multiple layers of spooling of the wire rope. Drum shall have flanges at each end of the wire rope spool to a height of not less than two rope diameters above the final layer. Drum grooves shall be LeBus International, Inc., Longview, Texas or equal. Drum grooves must provide correct and repetitive action of layer of wire rope spooling throughout the hoisting range. This wire rope grooving, when combined with proper fleet angle control, will force the cable to conform to the proper spool pattern, and control the position of each succeeding layer to prevent abnormal wire rope spooling such as "cutting in" or skip wrapping.

The wire rope groove radius, depth of and spacing shall be as recommended by LeBus international. In order to accommodate lifting the four corners of the platform in a level manner the tolerance of the drum pitch diameter of each of the four hoists in the four hoist system shall accommodate equal lift speeds by the synchronized hoist motors. The rope length shall be accurately controlled to assure each hoist transition to successive wire rope layers together so the drum pitch diameter and line speed remains constant between the four hoists.

The wire rope fleet angle shall not be greater than 2 degrees.

Wire rope dead ends to the drum shall be by means of rope clamps or a swaged terminal in a keyhole slot. The drum and other parts shall be designed and fabricated to allow convenient inspection of hoist rope termination. Fastener holes shall be located between the clamp grooves. A minimum of two fasteners shall be provided for each rope clamp. When wire rope sockets are used, end grooves of the drum barrel shall be turned into the anchor point with a radius of not less than six rope diameters. The rope socket shall be anchored inside the drum against a rigid surface which is welded in place. The holes in the drum barrel for insertion and removal of the socket and rope shall be closed with pipe plugs or a bolted keeper plate to prevent the rope from coming out should the drum be overdriven in the down direction.

#### 2.4.5 Bearings

All bearing shall be precision, antifriction type. They shall be installed

in accordance with the manufacturers recommendations. Bearings shall be fitted with pressure lubrication fitting conforming to industry standard practice or permanently lubricated. Pressure fittings where provided shall be easily accessible from a safe location. Bearings shall be lubricated for their application and shall be shielded or sealed to prevent leakage.

Exposed bearings and load block bearings shall be pre-lubricated and factory sealed.

#### 2.4.6 Keys and Keyways

Custom design keyways shall be the parallel type and machined /fitted to ANSI B17.1, Class 2, fit requirements for the respective shaft diameter. Keys and keyways shall be dimensioned, with tolerances on the drawings. The manner of key installation shall preclude a key shifting out of its intended position.

Commercial hoist manufacturer's standard key/keyway design assemblies are acceptable.

#### 2.4.7 Couplings

Hoist couplings shall be connected between the hoist motor shall be a flexible type, grease lubricated. Coupling rating shall be not less than determined by the coupling manufacture's published selection methods based on operating speed, design horsepower, dynamic effects and brake torque. Couplings shall be located immediately next to bearings. Couplings shall be suitable for its location within the hoist machinery. All machinery alignment shall be within the coupling manufacturer's tolerance for parallel offset and angular alignment (and their combination) and shall accommodate all loading conditions of the hoist. If external gearing is provided, alignment of gearing to achieve full face width contact at rated load shall be provided. Machinery arrangements such as three bearings on the same drive shaft are not permitted, they must be separated by an appropriate coupling of a full flexible type or half flexible as needed. Couplings shall be lubricated as recommended by the manufacturer. All couplings shall be press fitted and keyed.

### 2.5 MOTORS

Motors shall conform to NEMA MG 1. All motors shall be minimum 60 minute duty rating. Motor insulation shall be Class H with a Class B temperature rise. All motors shall be equipped with thermal trip type over-temperature protection and shall provide warning and over-temperature indications to the operator.

#### 2.5.1 Hoist Motors

Provide AC inverter duty, totally enclosed non-ventilated (TENV), squirrel cage induction type hoist motors.

##### 2.5.1.1 Control Devices

All control devices including motor starters, contactors, circuit breakers and the like shall be per Section 26 05 71.00 40 LOW VOLTAGE OVERCURRENT PROTECTIVE DEVICES.

## 2.5.2 Adjustable Frequency Drive Controls

### 2.5.2.1 Hoist Electric Drive Controllers

The hoist controller must enable the drive motor to develop full torque continuously at zero speed. The motor drives shall be Magnetek Electromotive flux vector Impulse VG+ series 4 motor drives or approved equal. The drive shall be listed to UL 508C.

The drive unit shall have the following control components, application software features:

1. Reverse Plug Simulation function that allows the operator to smoothly and quickly stop and change directions without setting the brake.
2. Encoder loss detection.
3. Phase loss detection.
4. Brake test allowing testing of available brake torque.
5. Snapped Shaft Detection.
6. Provide a redundant hardware safety circuit that guarantees motor and brake power are removed when an E-STOP switch or safety controller opens that drive.
7. Ground Fault protection.
8. Key pad display including diagnostics.
9. Stall Prevention.
10. Static Auto Tune.
11. Load checking that prevents lifting an overload (thermal overload protective device).
12. Output accuracy 0.01% or greater.
13. Braking torque 150%.
14. Thermal Overload UL recognized.
15. Drives shall conform to CENELEC EN 61800-3.
16. Fault reporting capability

### 2.5.2.2 Hoist Control Panels Stations

The Hoist Control Station shall be provided for each 4 hoist system. Each control station shall consist of a Central Control Station located adjacent to the hoists.

The Central Control Station shall have a selector switch to switch between inching speed, normal speed and empty hook speed. The Central Control Station shall each also have an emergency stop button.

The Central Control Station shall be provided with a control parameter settings to synchronize hoist movement where all four hoists are operating together. The drive shall synchronize hook speed of all four hoists. Speeds shall be regulated regardless of the load on any platform corner to provide level movement of the platform.

The Central Control Station shall be provided with an independent control of each hoist so that any one hoist can be selected and operated. Also control station will provide for all four hoists or two east hoists or two west hoists operated together with synchronized hook speeds regardless of load on the hooks.

The hoist central operator's control console shall be built with superior workmanship and attention to detail. This includes proper layout of controls and uniform console appearance.

Considerations pertaining to correct human factors practices shall be provided. Legibility of all displays and access to components shall be provided.

The hoist central operator's control console shall be designed with consideration to a preliminary control console arrangement provided on the contract drawings. The final design shall include consideration to access of controls on the operator's station, visibility of controls allowing for proper operator reach of control items.

The control console interior parts shall be arranged to provide good visibility for operation and maintenance access.

Console shall include ferrous metal construction, white painted control console with hinged and locking access doors that house interior control components, wiring and terminal strips.

Console interior shall be painted white and shall have a light to illuminate the cabinet interior.

The hoist central operators control console shall be provided with a dust cover to protect the console components when not in use.

The control console will include the following items:

Console Functional Requirements

Power on button

Stop button

Emergency stop

3 position hoist speed selector switch with the following choices:

Inching speed

Normal speed

No load speed

4 position selector switch with the following choices:

- Four hoists tandem lift

- Two east hoists tandem lift

- Two west hoists

- Independent hoist operation

4 position selector switch with the following choices:

- Hoist 1 NE

- Hoist 2 SE

- Hoist 3 NW

- Hoist 4 SW

Master switch control

Bypass key for final upper limit

Indicator lights as follows:

A run light for each hoist (green)

Power on light (green)

Hoist over temp warning (amber) and cutout light (red) for each hoist

#### 2.5.2.3 Dynamic Braking, Controlled Braking Means

Provide dynamic braking for hoist electric drives. The hoist brakes shall set after the associated controller decelerates motor to a controlled stop. Size the hoist controllers to provide sufficient starting torque to initiate motion of that drive mechanism from standstill with 0 to 125 percent of rated load on the hook. The hoist controller shall enable the drive motor to develop full torque continuously at zero speed. Drive

motors shall run smoothly, without torque pulsations at the lowest speed and be energized at a frequency not exceeding 60 HZ for the hoist drive.

## 2.6 HOIST LIMIT SWITCHES

Each hoist shall be furnished with upper and lower control limit switches to prevent hook over travel in either vertical direction. These switches electrical contacts shall be normally closed contacts. These limit switches shall allow the motor to come to a normal stop and allowing the brakes to set, and shall be set to attain maximum vertical hook height at any speed and to provide safe margins for drift.

The lower limit switches shall be a geared type control circuit lower limit switch. The upper control limit switch shall be paddle type control circuit upper limit switch. The control circuitry design shall ensure these limit switches stop motion in the protected direction and permit normal operation in the opposite back-out direction. These switches shall be located in accessible areas and shall reset automatically.

Each hoist shall be furnished with a second, higher power type, weight-operated upper limit switch. This switch's electrical contacts shall be a set of normally closed electrical contacts wired into the mainline circuit, hoist power contactor control circuit such that all hoist motion shall be precluded after the limit switch is encountered. This normally closed contact may be located in the low voltage circuit.

After the upper limit switch has been activated, normal movement of the load will require action (resetting) at the upper limit switch level. A upper limit switch bypass key shall be provided that will allow the operator to bypass the second upper limit switch and travel only in the downward direction for the sole purpose of landing the load safely.

The weighted upper limit shall be adjusted sufficiently low to ensure that the hoist will not two-block (or otherwise damage wire rope) if the hoist actuates the weighted upper limit at full speed with no load. Both limits shall be tested from slow speed to full speed to verify correct operation and clearance.

The geared upper limit switch shall be positioned low enough to prevent initiation of the weighted upper limit switch when travelling into the geared limit switch at no load speed. This limit switch shall be tested for correct operation and clearance.

## 2.7 BRAKES

### 2.7.1 Hoist Electric Holding Brakes

Each hoist shall be equipped with one electric holding brake electrically released, spring applied. Holding brake capacity shall be sized to produce 150 percent of the rated load hoist torque.

All brakes shall be adjustable from 50-100 percent of their rated capacity. Brakes shall have thermal capacity for frequency of operation required by service.

The brake shall be provided with a manual release mechanism, hand lever or other easily actuated release method. This feature shall not self-lock in the open position.



The brake system shall be able to accommodate manual lowering operation under full load. The contractor shall verify the brake can be manually release to allow the lowering of the load at a slow controlled manner to allow operators to safe the load upon a control system failure.

The Contractor shall provide a hoist holding brake release indication for control verification. This may include adding a proximity switch or other device to the brake shoe linkage. This must indicate a physical movement of the brake linkage, not energizing the brake coil. This brake release information shall be provided to the control system to assure brake release occurs correctly, to enable hoist run commands.

All brake shoe friction material shall be non-asbestos type.

#### 2.7.1.1 Brake Safety Guards

The Contractor shall provide an enclosed hoist brake or provided with metal safety guards. These guards shall be shaped to provide close fitting protection so moving parts are guarded from contact with personnel and shall protect against debris from falling onto the brake wheel. These covers shall be easily removable to accommodate inspection and maintenance.

### 2.8 LOAD BLOCK AND SHEAVES

#### 2.8.1 Gear Assembly

The 75-ton hoists shall have an enclosed gear reducer selected by the hoist manufacturer. AGMA rated certified helical, herringbone spiral bevel type or their combinations may be used for hoist. Worm drive reducers are not acceptable. The reducers shall be base mounted and shall be standard products of manufacturers regularly engaged in production of this type of equipment for commercial applications. Housings shall be ridged and properly shaped to maintain precise alignment of gears and support of bearings under varying loads. Gear orientation and bearing location within the enclosures shall provide a means for oil lubrication of the mating surfaces of the gears and bearings. The housing shall include inspection covers for inspection of gears at meshing points, a breather, a cover or closed filler opening, a pipe plug closed drain opening that is accessible and capable of draining the contents down into a pan or bucket.

The enclosed gear reducer for the 7-1/2 ton hoist shall be integral to the commercial hoist and equipment frame. Worm drive reducers are not acceptable. The housing shall include a breather, a filler opening, a pipe plug closed drain opening that is accessible and capable of draining the contents down into a pan or bucket.

### 2.9 PAINTING SYSTEM

Painting shall be in accordance with specification section 09 97 13.00 98.

Items not to be painted (protect for shipping only)

Items such as rubber parts, flex hoses, electrical cables, mechanical linkages such as shoe brake adjustment linkage (paint brake body), chain and sprocket assemblies, timing wheels and the like shall be left uncoated.

Items such as carbon steel motor shafts, flex couplings, and the like shall be protected from corrosion during shipment with a suitable corrosion protection coating such as Cosmoline, (or approved equal). This shall be

applied to these areas before shipment. Cosmoline shall be reapplied at the end of acceptance testing for lasting corrosion protection in the hoist environment.

Items such as threaded fasteners and threaded studs shall be left unpainted. These items shall be coated with a long term corrosion protection film barrier such as Zep Linebacker (or approved equal). This film shall protect against corrosion on outdoor surfaces that resists rain, salt water and many corrosive industrial environments. This can be easily removed with a solvent or degreaser when desired.

## 2.10 SOFTWARE AND HARDWARE

This Section is required only if the contractor chooses to use a control PLC in the design of the hoist controls. At that time all parts of this section will become applicable.

All communication between microprocessor, electronic systems and application software shall be of the speed and data quality such that operations between units appear seamless. Random communication faults will not be acceptable. All software systems shall be tied together with a common clock such that when comparing reported data events within or between systems it shall be discernable to the relative timing sequence of when these events occurred relative to each other.

All hoist communication and software related wiring shall be protected against outside interference and static noise. Any loss of communication between software systems, on either primary or redundant channels, shall be detectable and reported as a system fault. It shall be determined whether this loss of communication is sufficient reason to automatically shut down hoist operations or whether the hoist can continue operations. These determinations shall be approved by the Contracting Officer.

Two new laptop computers with individual protective carrying cases shall be provided with this contract. Both laptops shall be loaded with identical software containing all the software development platforms used to develop custom software for these hoist systems as well as any software written specifically for these hoist systems. Two back-up copies shall also be provided on non-volatile memory such as a memory stick or card. All software licenses and software code custom written for these hoists or hoist systems shall become the property of the Government. Any passwords, keys, locks, etc shall be given to and become property of the Government. There shall be a procedure available to allow for password changes. All interface cables needed for communications between the laptop and hoist devices shall be provided for each laptop. The laptop shall be able to connect to the PLC directly or through Ethernet.

Laptops shall be able to communicate with data systems on the hoists when directly connected to hoist interface components. When the laptop(s) is connected to devices on the hoist through direct connection, there shall be no restrictions except for password protection.

The laptop(s) shall be able to view operating software and operating logic "real-time" to the greatest extent possible. Where individual devices are monitored, such as relays, encoders, brakes, master switches, potentiometers, switches, etc the laptop displays shall show the changes of states of these devices as they occur as well as the internal ladder logic (or equal) state changes within the PES or other software devices.

The control PLC shall monitor communication health.

## 2.11 HOIST, ELECTRICAL AND CONTROL REQUIREMENTS

The operator input has direct control of the speed. Provisions shall be provided so that the hoist control system can tolerate both actuation of an emergency stop and loss of power or the interruption of over-current protection devices without damage to components under normal loading conditions. In order to mitigate software corruption due to power transients, provisions shall be made to insure that line power supplied to microprocessor based devices is conditioned to remain within the input specifications of the devices and is monitored by the control system which shall initiate a shutdown upon detection of the out-of-tolerance condition. Provide UPS for these functions with 10% spare capacity and full load run of 30 minutes.

Performance response to controls shall be instantaneous, except where time delay devices and relays are provided. Operation shall be smooth and quiet. Heat rise in motors, brakes, and transistors during maximum capacity operation shall not exceed the design limitation.

The control system shall include over-current protection, under and over-voltage protection, phase loss protection and line transient protection. The system shall be capable of detecting these conditions before they adversely affect the control system and perform a safe and normal shut-down. All control system shall conform to NFPA 70.

Protective devices shall include a fused circuit disconnect switch for each motor controller.

Provide enclosed type circuit breaker readily accessible to the hoist operator for hoists disconnect (ability to open and close the breaker without opening the enclosure). Provide for lockout/tagout of all hazardous energy sources.

Each hoist system shall be equipped with an emergency stop function that will remove power to the entire four hoist system. This can be accomplished using a shunt trip on the main isolation breaker or a main contactor just downstream of the main isolation breaker.

On AC motors, overload relays shall be provided for each phase of the motor windings. Operation of any protective device (overload, under voltage, undercurrent, control-circuits fuses, or stopping device) shall safely stop hoist motion, without any adverse affects on the control circuit.

Safety devices and brakes shall be positive in action without slipping, chattering, or jamming and shall have a fail-safe design.

The hoist control system shall not permit a failure causing the hoist to fail to a higher speed range then commanded. Failure to a lower speed range or stop is permitted.

All hoists shall be capable of simultaneous and independent operation without degradation of control function.

The hoist controls shall not allow inadvertent initiation of a run command. All master switches or motion control devices out of center or neutral position upon power up shall prevent any hoist movement.

The hoist master switch will be used for normal operation in inching, normal and empty hook speed ranges. Pulling the master switches toward the operator will raise the load and pushing the master switch away from the operator will lower the load. Neutral position will bring the load to a controlled stop and set the brakes.

All speeds shall be maintained to within plus or minus 2 percent of commanded speed.

A standard closed-loop system consisting of an AC induction motor controlled by a flux vector drive shall be used for the hoist motors. Each motion shall have an independent drive for each motor. Selected speeds shall be constant, without any fluctuation within a (+/-) 2 percent error tolerance loaded or unloaded. On a closed loop system the control system shall provide programmable acceleration and deceleration functions. All acceleration shall be continuous with no stepping, and shall follow a near linear slope. Controls shall be able to maintain (+/-) 0.005 inches load position without drift of the load upon brake release and brake engagement. Power system harmonic performance shall be per IEEE 519.

Provide static reversing, adjustable frequency flux vector controllers for hoists electric drives. Provide dynamic braking for all electric drives. All electric drives should be sized with dynamic braking resistors capable of bringing the rated load to stop without overheating the drive.

The hoist brakes must set only after the associated controller decelerates the motor to a controlled stop.

## PART 3 EXECUTION

### 3.1 GENERAL

The hoist manufacturer shall provide a qualified erection superintendent to supervise the delivery, unloading, assembly, and erection of the hoist systems to inspect and approve the installation; and to place each system into operation.

Each hoist shall be assembled at the factory, properly wired, tested without load, and disassembled only as required for shipment. Each disassembled part shall be match marked or otherwise controlled for final field assembly.

The sequence of acceptance testing for all hoist systems shall be completed in order to assure individual hoists, two hoist and four hoists systems function properly. This is to assure safe platform handling and (assuming the hoists are used to initially install the platforms) assure safe platform installation onto T-rails.

Testing is also completed to assure proper function of the hoist systems, and platforms systems. This including alignment and interface with platform T-rail system with all platforms and platform corbels.

Hoist system performance will be demonstrated to assure proper hoist performance is provided to move any platform (with and without dead load on the platform) to a new elevation. This includes raising the platform to unload its support pins on the corbels, retracting corbel pins and then raising or lowering the platform to a new elevation where corbel pins are aligned and re-inserted into the t-rails.

Prior to installation of a platform the each hoist system will be tested for proper system function in accordance with unloaded and loaded testing requirements using test weights. This includes single hoist, two hoist and four hoist tandem operational tests. Also hoist proof-load, hook measurement and NDE shall be completed.

After functional acceptance testing the hoists maybe used for initial platform installation. Platform installation will also be used to assure proper performance of the platforms, its T-rails and corbels.

Once the platforms are installed functional testing of the hoist systems shall be completed to demonstrate proper hoist platform interface and platform movement to new elevations.

Post acceptance testing inspection will be completed after all its respective platform installation and functional demonstrated is completed.

### 3.2 ERECTION SERVICES

The hoist systems shall be erected in accordance with the manufacturer's printed and approved instructions and as directed by the manufacturer's erection superintendent and in his presence. Adequate and safe erection equipment and rigging shall be provided by the Contractor as required to install and test the hoists.

### 3.3 FIELD QUALITY CONTROL

#### 3.3.1 Post-Erection Inspection

After erection, the Contractor, the Contracting Officer, and a hoisting system manufacturer's representative, shall jointly inspect the hoist systems and components to determine compliance with specifications and approved submittals. Notify the Contracting Officer 10 days before the inspection.

### 3.4 TESTING

#### 3.4.1 General

The hoist shall be tested in the shop prior to shipment and after installation. All testing shall be witnessed by a designated NASA Representative. The manufacturer shall prepare detailed, step by step, test procedures, with blank space for date, Contractor/Designated NASA Representative acceptance, description of item to be tested, how it will be tested, and acceptance limits. Submit test procedures to the Designated NASA Representative for approval at least 30 days prior to testing and make additions and deletions as noted. The Designated NASA Representative shall be given a minimum of two weeks notice before the start of testing. The Contractor shall not start any Government required testing until he is prepared to conduct all such tests. The Contractor shall repeat any test, or portion of a test at the direction of the Designated NASA Representative where the Designated NASA Representative determines that a subsequent adjustment has affected a previously demonstrated capability. The Government reserves the right to require additional testing on any component or system that shows signs of deficiencies, potential failure or other anomalous performance, until determined acceptable by the Designated NASA Representative. The Contractor shall take immediate action to correct any deficiencies disclosed by test and shall rerun the test as directed by the Designated NASA Representative. The Designated NASA Representative

shall be given a reasonable period of time to evaluate results before notification of acceptance. The Contractor shall be the test conductor and record time and conditions for each test. A reproducible copy of the completed test, with data, shall be provided in accordance with submittal requirements.

#### 3.4.2 Certification and Inspection Test Reports

Certification and inspection test reports for shop testing and acceptance testing shall be provided as required in paragraph of this section entitled "Certificates of Compliance".

#### 3.4.3 Shop Assembly and Testing

Shop testing will be completed on one four hoist set of 75-ton hoists and its associated control console and one four hoist set of the 7-1/2 ton hoists and its associated control console. Shop testing of the other two four hoist sets and their control consoles will not be witnessed by the government. Testing of these hoist systems is the responsibility of the Contractor. Full acceptance testing of all units shall be completed during a acceptance testing on site. The Contractor shall be responsible for full compliance with all contract requirements for all equipment.

The hoist and hoist control system shall be fully assembled for shop testing purposes. Assembled panels and hoist control console and four hoists shall be temporarily wired and powered with the motor drive programmed and tuned to the appropriate configuration at the Contractor's plant. Equipment shall be wired and examined visually and dimensionally for fit, quality of material, adjustment, workmanship, finish, etc.

For the purposes of the shop testing "fully assembled" shall mean that all hoist control elements shall be assembled in the shop to permit the demonstration of the full function of the control system performance requirements specified. This will include all control panels (fully assembled) and hoist operator's console (fully assembled) with all systems temporarily wired for full functional testing. Hoist shall be tested for proper operation and clearances. Each hoist shall be assembled for testing on its equipment base, without reeving.

Safety covers and guards, etc. that will be removed for shipment need not be in place. All safety covers shall be present and fit checked prior to shipment. Electrical pull box and junction box covers need not be installed when electrical connections wire numbers, etc. are exposed for inspection, troubleshooting.

The shop test shall demonstrate all operational control functions the hoist controls are designed to perform. Hoist speeds in both directions shall be checked and recorded. All brakes shall be checked for proper operation and clearance. Hoist brake torque shall be static tested by using a torque wrench and by using the motor drive brake testing feature. This test will show the torque required to slip the brake, as specified.

The Contractor shall provide a means to test the hoist holding brake at full design torque and loss of power. The brake shall be statically tested at 150% rated load hoisting torque for no movement and at 165% for slip. This method may include providing a shaft extension with a lug on the back or the new motor. Then using a torque multiplier manually apply a torque to the shaft extension using a calibrated torque wrench to measure the capacity of the brake. The Contractor shall provide the torque multiplier

and all fittings necessary to perform these tests. The torque multiplier special tooling and fittings shall be turned over to the government at the end of the contract.

Other approved methods for brake testing can be considered.

Repeat hoist brake torque testing using the hoist brake testing feature on the hoist motor drive to demonstrate this capability.

The drives shall be tested for correct operation. They shall demonstrate the movement and coordination and communication in a tandem operation of four hoists, two individual hoists (east and west groups) and as individual hoists. For all operating speeds and operating operational scenarios a accurate drum speed and positioning shall be measured for the simulated full range of motion. Verify motor drive encoder feed back speed is the same on each hoist within the published tolerance of the motor drive. Verify loss of encoder feedback is recognized by the motor drive.

Motor voltage and amperage shall be checked and recorded.

All limit switches shall be tested individually to assure correct operation including all limit switch by-pass functions.

Any deficiencies noted shall be corrected and re-tested prior to shipment.

#### 3.4.4 Acceptance Test

##### 3.4.4.1 General

During installation of the each platform level, the corbel clearance shall be verified to assure smooth vertical clearance of each platform along the length of the T-Rails (clearance will be verified from the bottom of the T-Rail up to its operational elevation).

Acceptance testing shall be completed on all four (4) hoist systems (a total of 16 hoists) and their control consoles completely installed and finished.

Acceptance testing shall be per the requirements of the Approved Test Procedure. The Contractors shall provide a competent on site engineer/technician to oversee and assist in the installation and acceptance testing of the hoist systems and their related control systems.

The Government will provide test weights and power for these tests. These tests shall be performed after final installation. Prior to testing, the hoist systems shall be inspected for damage during shipment and installation. The hoist systems shall be tested to prove that it meets all operating requirements for which it was designed.

##### 3.4.4.2 Acceptance Test Hoist Platform Systems

Unless an exception or addition is made all test requirements apply to the 75 ton platform hoists and 7-1/2 ton elevator landing hoist systems.

Unless otherwise noted, each test shall be completed separately on each hoist (as applicable) then repeated for each tandem hoist configuration and four hoist configuration.

If elevator access platforms or extensible platforms are not available

these tests shall be done using test weights.

Acceptance test shall include, but not be limited to the following:

Test all limiting controls and safety devices such as limits switches, and reset features etc. Demonstrate the design lift of each hoist.

Verify each hoists lower block, its reeving and slings have adequate clearance through full hoist travel. Note, the lower block may move laterally and twist throughout hoist motion.

Test all operating controls which the hoist is required to perform and other control features which are not otherwise called out in these tests.

Perform a no load test of hoist motions to verify operation in all speed ranges, for all motions.

Load test hoist at 50 and 100 percent of rated load to verify operation in all speed ranges for all motions. Also operate in all hoist speed modes at both loads, at 50 percent and 100 percent rated speed for 10 minutes in each speed and load except no load speed. Demonstrate variable speed in each speed range.

Demonstrate all hoist motions at 0, 50 and 100 percent load are smooth in all speed ranges including loss of power tests.

Test each hoist holding brake and then demonstrate the holding capability with the torque wrench and using the motor drive feature as completed during shop testing.

Demonstrate manual load lowering at 50 percent and 100 percent rated capacity of each individual hoist (reference paragraph 2.7.1). Using one elevator platform hoist demonstrate by safely lowering one corner of the elevator access platform one foot, or until the platform wedges itself into the T-rail. Using one extensible platform hoist demonstrate lowering one corner of the extensible platform one foot or until the platform wedges into the T-rail.

Proof load test of each 7-1/2 ton hoist at 125 percent rated load. Lift and lower the load in normal and inching speeds approximately 6 inches and stop and hold the load for three minutes. Confirm the holding brake does not slip. Raise this load 6 ft. stop hold the load for 3 minutes lower to the floor.

The 75-ton hoists shall be proof load tested at 125% rated load using separate test weights with a tandem lift of the two north hoist pairs and south hoist pairs. Each hoist pair will lift 125% rated load simultaneously to provide proof load of hoist and common upper block support structures. Test will include tandem lifting of the two test loads in normal and inching speeds approximately 6 inches. Stop the hoists and hold the load for three minutes. Confirm the holding brake on each hoist does not slip. Raise the load 6 ft. stop and hold the load for three minutes, lower the load to the floor.

Measure hook for hook throat spread before and after hook proof load test in accordance with paragraph 1.5.2 of this section. Measure the distance between tram points before and after load test. Hook NDE report shall follow in accordance with paragraph 1.5.4 of this section.



Check for motor overheating during each test. Each load test, at each speed range, shall be run consecutively without a break. If any adjustments are required during performance of the tests, test shall be voided and rerun.

Demonstrate accessibility and maintainability features of the Hoist System for lubrication, brake adjustment, and general maintenance by actual field evaluation.

Test to demonstrate hoist speeds while simultaneously operating the four hoist system at no-load. Accurately measure actual hook speeds of all four units. Verify motor drive encoder feedback speed is the same to each hoist within the published tolerance of the motor drive.

Repeat the hoist speed test when one hoist is loaded to 50 percent rated capacity, one hoist is loaded at 100% rated capacity and the other two hoists are unloaded. Simultaneously operate the four hoists system for one minute. Accurately measure actual hook speeds and encoder feedback speed of all four hoists. This will demonstrate hoist speed regulation when the four hoists operate at significantly different loads. Finally, repeat the test by moving the two test weights to the unloaded hoist pair, measure and record hoist speeds and motor frequencies (it is not necessary to rotate both test weights among the four hoists). After one minute of operation (at full hoist speed) the total travel distance of each hoist shall be within six inches of each other.

Full functional testing of the four hoist systems, all mechanical and electrical components, shall be demonstrated for both Extensible Platforms and Elevator Access Platforms. Testing shall include the following on all 20 platforms:

Platform unpinning platform movement to a new locations and platform pinning shall be demonstrated. This test will be completed on each platform. Platform will be moved 5 feet (or similar distance as determined by contracting officer representative) and moved back to its final operational elevation. If at the time of full functional testing the extensible platforms or elevator access platforms are not installed or available for testing this test, this test will not be required.

Demonstrate operation of the elevator landing hoists emergency stop control and reset features on each hoist control console and each remote emergency stop control location.

Demonstrate operation of the main platform hoists emergency stop control and reset features on each hoist control console. Main platform remote emergency stops are NIC.

The test procedure shall list all recorded data and acceptance ranges. Three copies of the completed test log shall be delivered to the Designated NASA Representative not later than 48 hours after the completion of each test.

At the conclusion of acceptance testing, the Contractor shall complete a detailed wire rope inspection on each hoist. Inspection and acceptance criteria shall be per wire rope users manual. All lifting slings to be turned over to the Government shall be inspected. Damaged slings shall be replaced at no additional cost to the Government.

### 3.5 OPERATOR TRAINING

#### 3.5.1 General

The Contractor shall provide a person(s) knowledgeable in the mechanical and electrical features, control characteristics, design function, and limitations of the hoist and various hoist control systems. This person(s) shall be knowledgeable at the engineering level of the hoist mechanical and electrical control systems.

#### 3.5.2 Personnel Training

The Contractor shall be required to conduct both classroom discussion and hands-on-operation of the hoists for approximately 20 people. These people will be the engineering, operators and maintenance personnel for the hoist system once it is turned over to the Government. Also included shall be discussion covering items in the Contractor furnished operation, service, maintenance and spare parts (O&M) manuals. This classroom activity shall be conducted at the job site after acceptance tests are complete. Class shall provide 1/2 day training to engineering personnel and 1/2 day training to operation and maintenance personnel.

#### 3.5.3 O&M Manuals

The Contractor shall submit 6 copies of the project Operation and Maintenance (O&M) Data Manuals specifically applicable to the contract and a complete and concise depiction of the provided equipment, product and systems stressing and enhancing the importance of the system operation, interactions and preventative maintenance.

O&M Manuals shall include the following information as a minimum (See Section 01 78 23, Data Package 5:

- a. Safety precautions
- b. Operator prestart
- c. Startup, shutdown, and post-shutdown procedures
- d. Normal operations
- e. Emergency operations
- f. Operator service requirements
- g. Environmental conditions
- h. Lubrication data
- i. Preventive maintenance plan and schedule
- j. Cleaning recommendations
- k. Troubleshooting guides and diagnostic techniques
- l. Wiring diagram, control diagrams and electrical schematics
- m. Maintenance and repair procedures
- n. Removal and replacement instructions
- o. Spare parts and supply list
- p. Product submittal data
- q. O&M as-built drawings
- r. Parts identification
- s. Warranty information
- t. Personnel training requirements
- u. Testing equipment and special tool information
- v. Testing and performance data
- w. Contractor information

-- End of Section --

